Vol. XIX. Part 8.

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The Journal of the Department of Agriculture of Victoria, Australia.

August, 1921.

PRINCIPAL CONTENTS

Nauru and Ocean Island Phosphate Deposits

Experimental Work in Western District

Peach Growing

Rupanyup Crop and Fallow Competition

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THE JOURNAL

OF

THE DEPARTMENT OF AGRICULTURE,

VICTORIA, AUSTRALIA.

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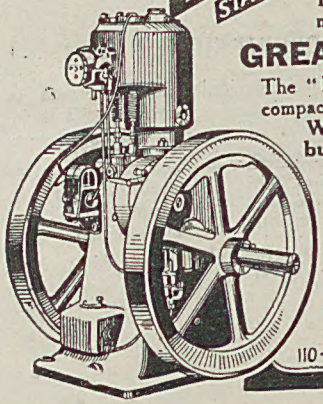

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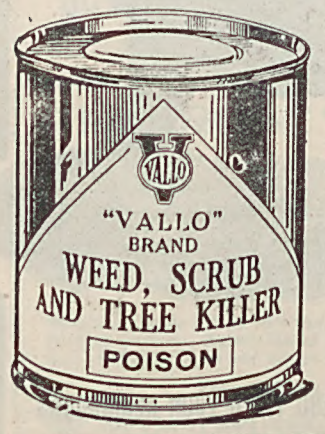

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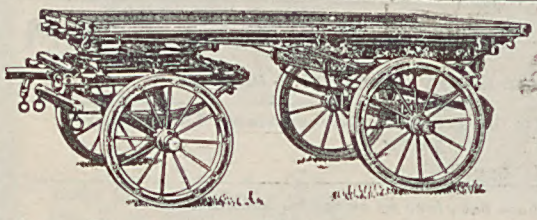

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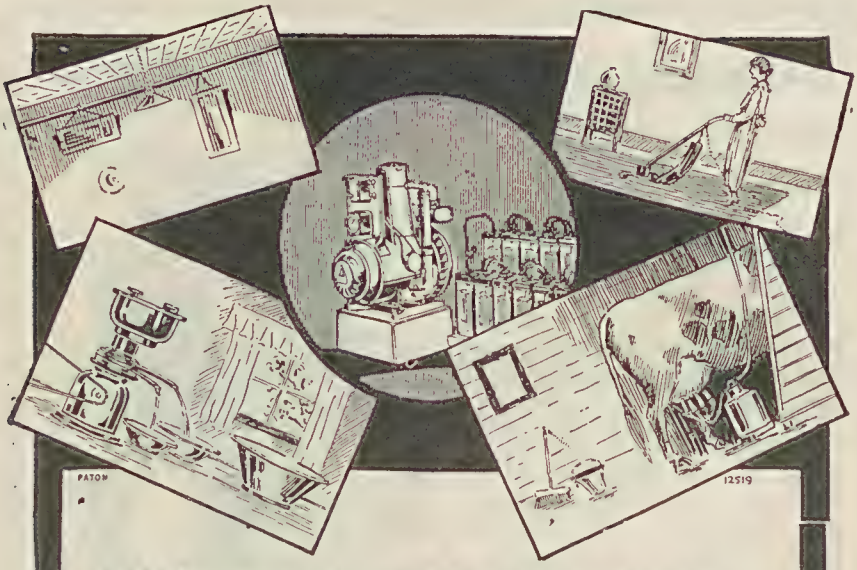

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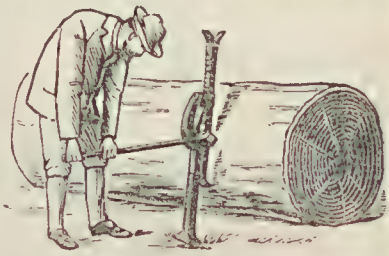

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OF THE

Department of Agriculture

OF

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Vol. XIX. August, 1921. Part 8.

NAURU AND OCEAN ISLAND.

THEIR PHOSPHATE DEPOSITS AND WORKINGS.

By Harold B. Popé, Commissioner for Australia.

Now that the Commonwealth is part owner of the phosphate deposits on Nauru and Ocean Island, Australians are entitled to know something of the undertaking in which nearly £1,500,000 of their money has been invested.

The Pacific Phosphate Company, from which the phosphate deposits on these islands were purchased, had a record of nearly 50 years in the Pacific, under the successive titles of John T. Arundel and Company, the Pacific Islands Company, and, finally, the Pacific Phosphate Company. Prior to the discovery, in 1900, of the Nauru and Ocean Island phosphate deposits, this company had worked, in different parts of the Pacific, several islands, such as Howland, Baker, Hull, Raine, Bunker, Lady Elliott, &c., &c. In those days operations were carried out on a very limited scale, and the ocean transport was practically all done by sailing vessels with a cargo capacity of from 800 to 1,000 tons each. To-day steamers are being loaded at Nauru and Ocean Island capable of carrying 6,000, 7,000, and even 8,000 tons each. The limited deposits on these "low-grade" islands soon gave out, and, just prior to the discovery of the Nauru and Ocean Island deposits, the company had worked out all the islands on which it had been carrying out operations. So scarce had phosphate in the Pacific become at this stage, and so hopeless did the chances seem of finding any more deposits, that the company, much against the better judgment of its most capable and experienced officers, had been impelled to return to some of its "worked-out" islands. But so completely had these already been gone over that it is no exaggeration to say that on one or two of them the phosphate had actually to be swept up with brooms

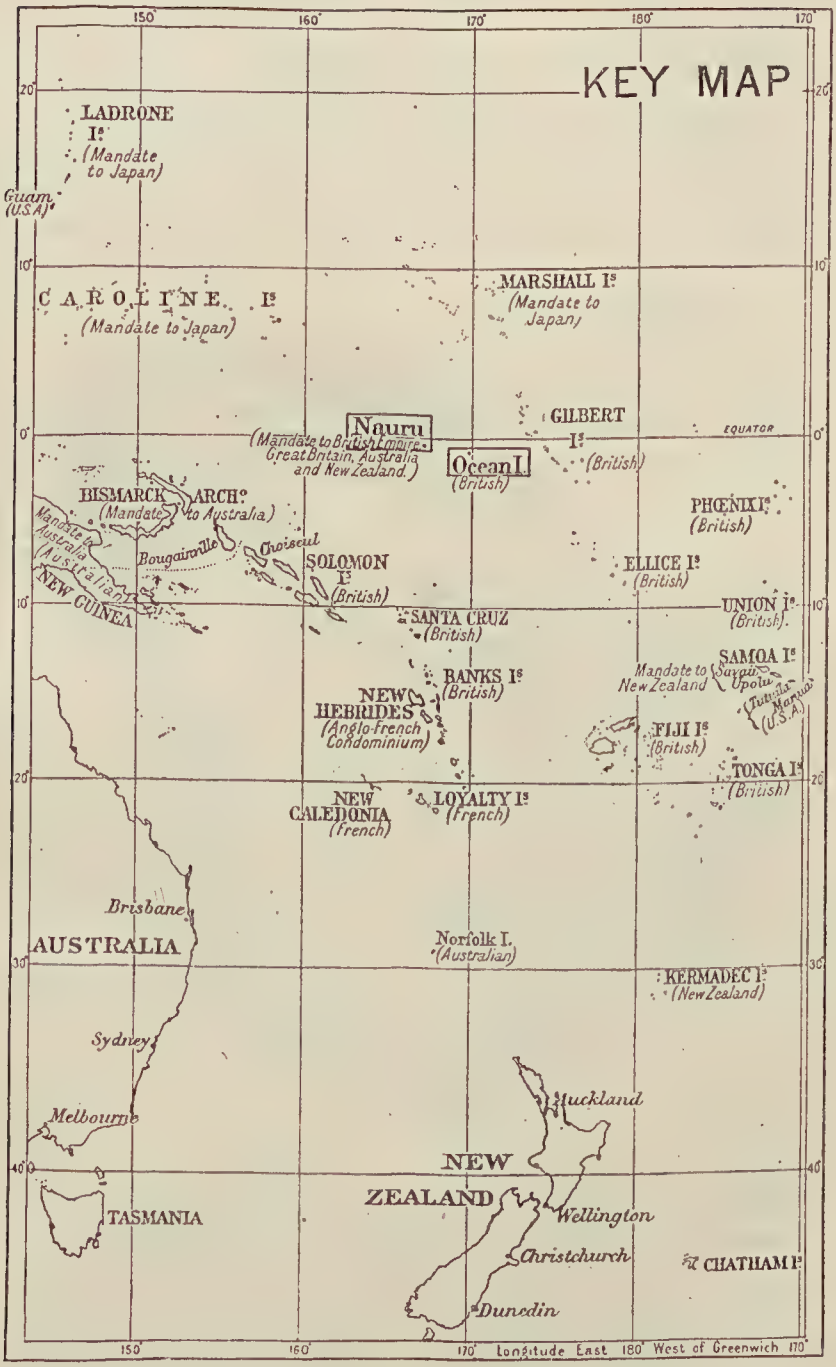
before a small cargo could be scraped together. However, the company (by this time the Pacific Islands Company) did not lose hope of one day finding another island, and, to tide it over the lean years, took to trading in copra. Several stations were established in the Gilbert, Ellice, and Marshall Islands, and the old *Archer* was the vessel employed to visit them periodically and collect the copra. In those days, and, in fact, right up to the outbreak of the Great War, Nauru was a German possession, and was included, for administrative purposes, in the Marshall group. For this same reason Ocean Island was included in the Gilbert and Ellice Islands by the British Government. One or two of the company's trading stations were located on Nauru, and it was on the occasion of one of the *Archer's* visits there, about 1897, that the supercargo, being on shore, noticed what appeared to him rather a strange-looking piece of rock, which he picked up and brought to Sydney with him. This piece of rock led to the discovery of the deposits at both islands, and will be referred to later. Keen competition and dishonest traders did not help to make the company's trading venture a success, and matters were at a very low ebb with it just prior to 1900, and the discovery of the deposits on the two islands.

Nauru (Pleasant Island).

Nauru was discovered by Captain Fearn, in the British ship *Hunter*, in 1798, and named Pleasant Island. It continued to be known as Pleasant Island till 90 years later, when, in 1888, the Germans annexed it, and reverted to the native name of Nauru, by which it is now generally known. Four years earlier, in 1884, the Germans had changed the names of New Britain and New Ireland to Neu Pommern and Neu Mecklenburg. It will be remembered that New Britain and New Ireland were discovered and named by that gallant and intrepid British explorer, Cartaret, when he sailed round the world in 1766-7.

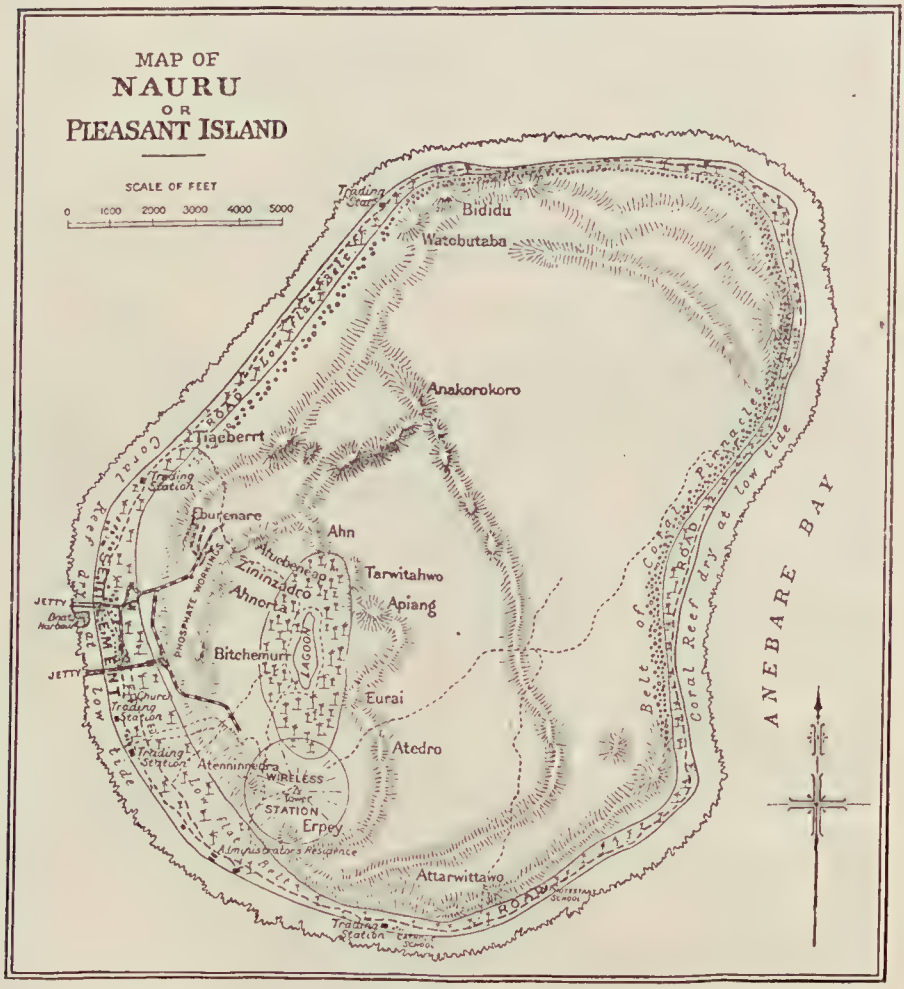
Nauru (for so it will continue to be called here, though it would be gratifying to see its old British name restored) is only 26 miles south of the Equator, lies in latitude 165 deg. 55 min. east, and is about 2,200 miles from Sydney, or ten days' run by the ordinary cargo steamer. The nearest land is Ocean Island, 165 miles to the eastward, and 52 miles south of the Line. Geographically, both Nauru and Ocean Island, which are merely isolated peaks, belong to no particular group of islands. The island has an area of about 12 square miles, and it has been estimated that six-sevenths of this is phosphate bearing. On the lower level, or atoll portion, a well-made road, measuring about 11 miles, completely encircles it. In addition, there are other roads passing over the high land into the interior, and crossing the island, but, though clearly defined, these are ill-formed and seldom used.

As is usual in the islands of the Pacific, Nauru is surrounded by a flat fringing coral reef, varying in width from 50 to 60 yards. At low-water spring tides the reef is bare, and at high water it is submerged to a depth of about 4 ft. 6 in. During neap tides usually 2 to 3 feet of water cover the reef. From the sea side, or outer edge, of the reef, the sea-floor falls rapidly at an angle of about 45 degrees, with the result that at 200 yards out the water is 200 yards or 100


KEY MAP
LADRONE Is
(Mandate to Japan)
Guam (U.S.A.)
CAROLINE Is
(Mandate to Japan)
MARSHALL Is
(Mandate to Japan)
Nauru
(Mandate to British Empire: Great Britain, Australia and New Zealand)
Ocean I.
(British)
GILBERT Is
(British)
EQUATOR
BISMARCK ARCH.
(Mandate to Australia)
Mandate to Australia (Australian)
NEW GUINEA
Bougainville
Choiseul
SOLOMON Is
(British)
PHŒNIX Is
(British)
ELLICE Is
(British)
UNION Is
(British)
SANTA CRUZ
(British)
SAMOA Is
Mandate to New Zealand
Savaii
Upolu
Tutuila
Manua
(U.S.A.)
BANKS Is
(British)
NEW HEBRIDES
(Anglo-French Condominium)
FIJI Is
(British)
TONGA Is
(British)
NEW CALEDONIA
(French)
LOYALTY Is
(French)
Brisbane
AUSTRALIA
Norfolk I.
(Australian)
KERMADEC Is
(New Zealand)
Sydney
Melbourne
Auckland
NEW ZEALAND
Wellington
Christchurch
CHATHAM Is
Dunedin
TASMANIA
150° 160° 170° 180° 170°
Longitude East 180° West of Greenwich

fathoms deep. The Pacific in this vicinity is so deep that both Nauru and Ocean Island must obviously be the tops of two fairly high mountains.

Approaching Nauru from the sea the vivid greens of the island, the white sandy beaches and surf, with the deep, rich blue of the ocean, form a pretty picture. The fringing reef is first encountered. From this a strip of beach rises to a height of about 30 feet above sea-level before merging into what has been mentioned as the atoll portion of



the island. This atoll portion, or level belt, commonly called the "flat," varies considerably in width, being over a quarter of a mile wide in some places, whilst in others it does not reach 100 yards. On this part of the island, where the native villages are located, there is no phosphate, and the coco-nut trees grow in great profusion. Having crossed this strip of land, where, on the western or lee-side, the European settlement (Yangor) is situated, what is generally known as the "cliff" is reached. There the land rises more or less precipitously to an altitude of about 220 feet above sea-level. This elevated portion of the

island is composed entirely of phosphate and coral pinnacles. In the interior there is a natural depression, falling almost to sea-level, and terminating in a small and very picturesque lagoon. A good road runs round the margin of this lagoon, which is heavily fringed with tall coco-nut trees. On account of the water being brackish it has been said that the lagoon is connected with the sea; but, as on several occasions it has almost dried up during long spells of dry weather, it would appear that it is fed by the soakage from the surrounding hills. It is curious to see how the natives have divided the lagoon up. Small, low embankments reaching about a foot above water-level define the boundary marks of the various native owners. A native owning a portion of this lagoon owns, of course, the fish in that portion. The fish, which grow to several pounds weight, are brought in a little water in half of a coco-nut shell from "pockets" in the fringing reef, when no bigger than an ordinary pin. Years ago a Nauruan considered that he owned the ocean immediately opposite his land on the coast, and woe betide any other native found fishing in those waters. Many a faction fight, I understand, has been started in this manner. Finally, Nauru might be roughly compared in shape to a man's hat, the fringing reef and atoll portion being the brim, the phosphate-bearing area the crown, and the lagoon (though it is not nearly in the centre) the dent in the crown.

The climate is healthy, and malaria unknown. Newcomers, whilst becoming acclimatised, sometimes contract what is locally known as "line-island" fever, a low, mild fever, which invariably spends itself after a few days. Throughout the year the shade temperature only varies from about 85 to 90 degrees Fahrenheit, with considerable humidity. The days are hot, though not unbearably so, as white clothes are always worn, and the nights, especially towards morning, are cool and refreshing. The prevailing winds are the north-east and south-east "trades," which usually blow steadily for eight months of the year. The remaining four months (November to February) constitute what is known as the "westerly" season, when the wind, invariably accompanied by torrential rains, frequently blows hard and continuously from that quarter. At times, however, as in 1910 and other years, fine "easterly" weather has extended throughout the whole year, whilst, on the other hand, "westerly" weather was experienced throughout the whole of the never-to-be-forgotten years of 1905 and 1911. The rainfall, though usually copious, and at times abnormal, sometimes gives out in the long settled spells of fine weather, when months have been known to elapse without the gauges recording a single fall. It is at such times as this that the condensing plants must work day and night.

The native population of Nauru numbers about 1,200. They are of fine physique, intelligent, and bright, and friendly in manner. They have, however, but little desire for work, and, when not engaged on communal duties, occupy their time in fishing, playing, eating, and sleeping. Wrestling seems to be the favorite sport of the young men, but in this they only indulge spasmodically. Though the native is healthy and sturdy looking, his system, strangely enough, appears to offer but little resistance to disease. Epidemics of influenza, dysentery, and, in one case, of meningitis, which have taken heavy toll of them,

passed the white population by practically unscathed. Their food consists mainly of coco-nuts and fish—the staple native diet throughout the Pacific—but with the money they receive for their phosphate, copra, trees, and fish, they buy from the local store quantities of rice, sugar, biscuits, beef (bullamacow), &c., &c. Intoxicating liquors and all scents containing alcohol are rigidly withheld from them, and there is a heavy penalty, under British rule, for the native found drinking sour "toddy," the fermented and highly intoxicating sap of the coco-nut tree.

The education of the native, up to the present, has been left solely in the hands of the missionaries. With the exception of the old folk, they all read and write in their own language, and, in addition, have a slight knowledge of arithmetic, geography, German history, &c. Under German rule, the German language was taught in the mission schools,

Nauru: Chinese Coolies Working in Phosphate Field.

with the result that several of the young Nauruans have some acquaintance with that language. Throughout the Pacific, English is the tongue most readily picked up by the native, and the Germans, notwithstanding all their efforts to introduce the German language amongst the New Guinea natives, had always to address the natives of those islands in "pidgin" English. The Nauruans speak a language entirely their own, and perhaps there are few, if any, smaller communities in the world that have had the whole Bible specially translated for them.

Nauru is divided into about twelve districts, over each of which is a chief. Under British administration it has been customary for these chiefs to meet once a month at the Residency to discuss with the Administrator matters of local interest. They are mostly old men, and, generally speaking, very fine types. Any instructions regarding communal work which the Administrator may have for the natives are

passed on to them through the medium of their chiefs, proclamations and general announcements being made known in the same manner.

The Germans did not have the "curfew," but under British administration the "Last Post" is blown by the police bugler at the Government Station punctually at 9 o'clock every night. This is the signal for all natives to be home, and for all coloured labourers not employed on night-work to be in their quarters, also for "lights out." Immediately the bugle is sounded the nearest native chief blows a conch shell horn to warn his own village. The chief in the next village picks up the warning in the same manner, and so on right round the island. In cases of sickness, &c., permission to burn a light can readily be obtained. When the regulation first came into force on Nauru, after the deportation of the Germans, it was very unpopular with the natives, but the soreness it caused soon passed away.

How the Deposits were Discovered.

The credit of discovering the phosphate deposits on Nauru and Ocean Islands is due to Mr. Albert F. Ellis, who has been selected by the New Zealand Government as its Commissioner on the British Phosphate Commission—and the distinction could hardly have fallen on one more worthy or more deserving of it. Mr. Ellis has had 35 years' experience in the Pacific, and his knowledge of that vast ocean and its myriads of islands is most extensive. He has quite recently written the account of how he made the discovery, which I will give in his own words.

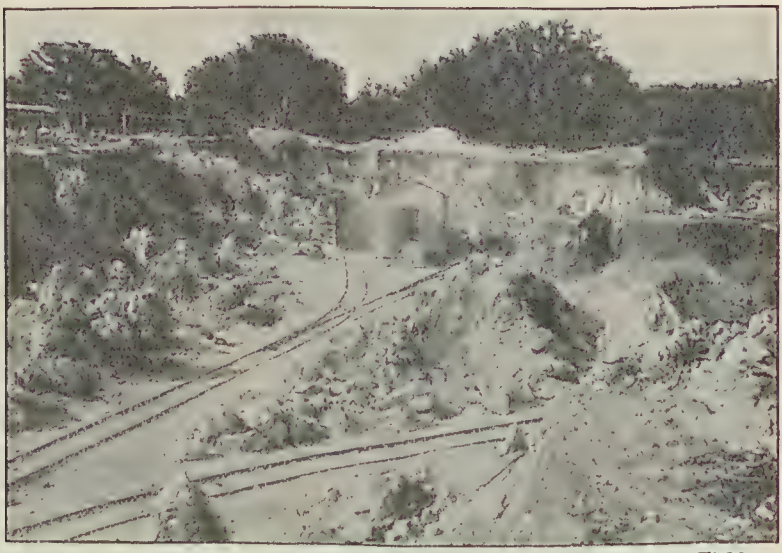
Mr. Ellis' Story.

"Hitherto no first hand account of the discovery has appeared in print, and such accounts as have been written contain various inaccuracies. Just prior to 1900 I had been serving as manager of one of the islands of the Pacific Islands Company on the Queensland coast, and had been transferred to the company's Sydney office, where an analytical laboratory had been installed for the purpose of dealing with samples of cargo, &c. My attention was arrested by a large block of rock used for keeping open the door of the laboratory; in some ways it resembled a rare kind of phosphate rock, of which a small deposit had been found in a deep depression on Baker Island, in the Phœnix group, several years previously. On mentioning the matter to the company's manager, I was told that it was a lump of petrified wood found by him on Pleasant Island (Nauru) some three years previously, and that one or more geologists had agreed as to its nature. This seemed decisive enough, but somehow, when working in the laboratory, that piece of rock repeatedly attracted my attention, and some three months afterwards the thought occurred, 'Why not test it?' A chip was knocked off, ground up, and tested for phosphate, with such a decided reaction that a complete analysis was made, and the humble door-chock proved to be phosphate rock of the highest quality. Moreover, from its formation, there were evidences that it came from an old and probably extensive deposit; as to the latter the manager was very emphatic.

"The question then arose as to how the deposit could be obtained, and this matter was promptly taken in hand by the company's head office in London. The position was that a large German Chartered Company held mineral and other rights over the German Caroline and

Marshall Islands, north of the Equator, and also over Nauru. On the other hand, the Pacific Islands Company, which was the immediate predecessor of the Pacific Phosphate Company, held numerous cocoanut properties and trading stations on the German islands which the Chartered Company referred to was particularly desirous of acquiring. Negotiations ensued, with the ultimate result that the Germans acquired the trading stations on their own islands, and the Pacific Islands Company obtained the concession to work Nauru. The Germans also received a certain number of shares in the company, and a royalty per ton on the phosphate exported, so that it was a transaction which proved profitable to them, though not to the extent that it did to the Phosphate Company and to British interests generally."

The shares in the Pacific Phosphate Company which the German company (the Jaluit Gesellschaft) secured were declared and delivered



Nauru: Railway Lines Branching off Main Line into a Phosphate Field.

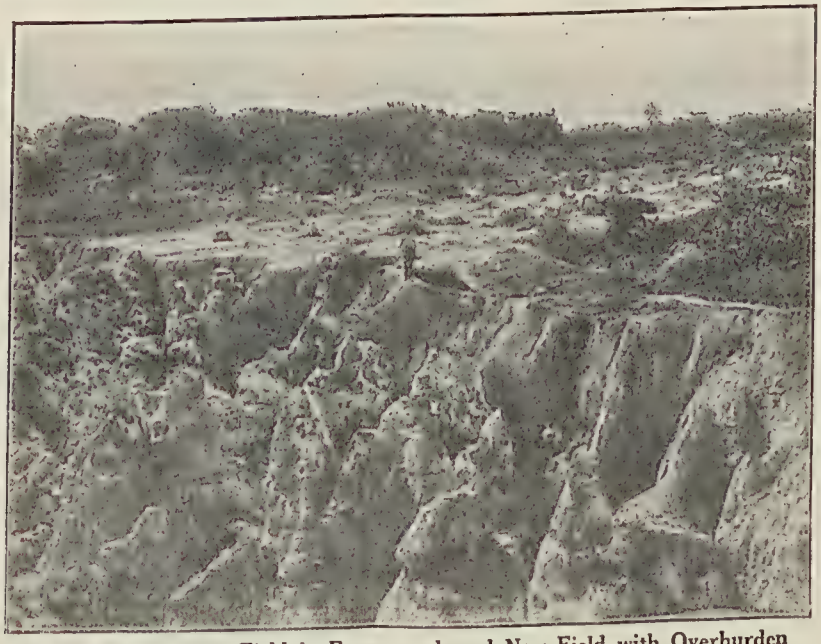
to the Public Trustee in London immediately after the outbreak of war. They were sold by public auction, and bought by a large English shipping company, thus automatically making the company controlling the Nauru and Ocean Island deposits an entirely British concern.

When Mr. Ellis made his discovery it was rightly concluded that, as Ocean Island was in the immediate vicinity of Nauru, and of practically the same formation, similar deposits would, in all probability, be found there. Such proved to be the case, and as Ocean Island was British (though it was not formally annexed and proclaimed a British possession till Captain Tupper, of H.M.S. *Pylades,* annexed it in 1901), operations on that island were commenced first.

The Extent of the Deposits.

Quite a number of misleading statements as to the quantities of phosphate on Nauru and Ocean Island have been made. But it can safely be said that, at the present moment, there are on Nauru and

Ocean Island not less than 100,000,000 tons of some of the highest grade phosphate known to exist. Soon after the Pacific Phosphate Company commenced operations on Nauru it sent an eminent Australian mining engineer to make a survey of both islands, and to ascertain, as nearly as possible, the extent of the deposits. This expert subsequently reported that there were at least 42,000,000 tons on Nauru, and about one-third of that quantity, or 14,000,000 tons, on Ocean Island. Several years later another mining expert was instructed to make independent surveys and calculations, with the result that he fully confirmed the figures given by his predecessor. These quantities worked out at a certain number of tons to the acre for the total acreage available. Experience gained in working Nauru for the last fifteen years and Ocean Island for the past 21 years (Nauru was commenced in 1906 and Ocean Island in 1900) proves, however, that these



Nauru: Worked-out Field in Foreground, and New Field with Overburden Removed and Ready for Working.

figures can be doubled, and the resultant total of 112,000,000 tons would still be within the mark. About 3,750,000 tons have already been removed, but, as already stated, there are, at the present moment, not less than 100,000,000 tons of available phosphate. How much more there might be it is impossible to say, for the comparatively few fields classed as "worked out" were abandoned, not because the phosphate was exhausted, but because it had become difficult to work, deposited as it is between coral pinnacles. After a depth of from 20 to 30 feet between the pinnacles has been reached, it does not pay, under present conditions, to work that field any further. The deposits on Ocean Island have been estimated by Mr. Ellis, the Commissioner for New Zealand, at probably 30,000,000 tons of available phosphate, but, he adds, this quantity may be much exceeded.

The quality of the phosphate from these islands is particularly high. Throughout their working history (a period extending over 21 years) the cargoes shipped from both have consistently averaged from 85 per cent. to 88 per cent. tribasic phosphate of lime. As a matter of fact that portion of the workings on Ocean Island known as the plateau has yielded, for some time past, phosphate averaging as high as 88 per cent. This, it is believed, is without parallel in the history of phosphate mining. The phosphate deposits on the French island of Makatea, near Tahiti, in the Pacific Ocean, are rich, but they fall short of the Nauru and Ocean Island standard. Though the Ocean Island phosphate is slightly higher in quality than the Nauru product, the latter lends itself better to the manufacture of superphosphate, and, generally speaking, is preferred by the super. manufacturers on that account.

A question often asked is, "How long will the deposits last?" This, of course, depends upon the rate at which they are worked. The Australian demand for Nauru and Ocean Island phosphate 20 years ago was only 20,000 to 30,000 tons per annum. This year over 200,000 tons are required. It is hoped that the total output from Nauru and Ocean Island will soon reach 500,000 tons per annum, but even if an annual output of 500,000 tons from each island is reached and maintained, it must not be forgotten that there are at least 100,000,000 tons to be removed before the deposits will become exhausted. The Australian farmer, therefore, has no need to be anxious about his supplies of superphosphate. Whatever may happen in less fortunate countries, his supplies are assured for the next four or five generations at any rate.

There has been considerable conjecture as to how these extensive and wonderfully rich deposits came into existence. What is known as the bird theory is the most popular and generally accepted. And it is in all probability correct, for phosphatized fish bones, shark teeth, &c., are continually being discovered. The writer himself found on Nauru in 1907 a phosphatized egg about the size of a hen's egg. When this egg was broken the "yolk" fell out—a solid pebble of phosphate. The "white," or albumen, was represented by several layers, each as thin as, or thinner than tissue paper. But the original guano, in the form of bird excreta, must have been deposited many thousands of years ago. There is evidence that the islands have been submerged on several occasions. The result is that all impurities have long since been washed away, and practically only the pure phosphate of lime remains. There is no odour or unpleasantness of any kind, and, to the unpractised eye, the Nauru and Ocean Island phosphate is no different in appearance from ordinary friable, light-brown soil. Occasionally it takes the form of rock, some of which is as hard as granite, with a surface which will take a polish equal to any marble. Curiously enough, the birds believed to be responsible for these deposits are now extinct, and the islands to-day, with the exception of a few terns, noddies, and frigate birds, are practically birdless.

The outbreak of war found the Pacific Phosphate Company controlling the deposits on both islands. On the 4th August, 1914, the white staff on Nauru was about two-thirds British and one-third German. Soon after the commencement of hostilities in Europe, Nauru was placed under martial law, and the British there subjected

to all manner of petty indignities till their deportation was ordered, on the 5th September, by the representative of the German Government. They were then given only a few hours to pack and get away by one of the company's small time-chartered vessels (the Norwegian steamer *Frithjof*), which happened to be there. This ship took the British subjects to Ocean Island, where a warm welcome greeted them. The deportees were absorbed into the staff on Ocean Island, where they remained till two months later, when the Commonwealth authorities sent up, by one of the company's large time-chartered vessels, the *Messina,* a detachment of about 66 Australian soldiers, under the late Brigadier-General Holmes. From Rabaul, where the *Messina* picked up the soldiers, the vessel proceeded to Ocean Island, where the British deportees, with their wives and children, were taken on board. The next day the voyage was continued to Nauru, where General Holmes was prepared to force a landing if necessary. But though the Germans, with their strong force of armed and trained native constabulary, were about equal in numbers, they wisely attempted no resistance, and were themselves deported to Australia, *viâ* Rabaul, by the *Messina* the following day. Only a few days after the British were re-established in their homes, a Japanese battleship and trooper, with troops on board, arrived to take possession of the island in the same manner as the German Caroline and Marshall Islands, north of the Equator, had already been occupied by that nation.

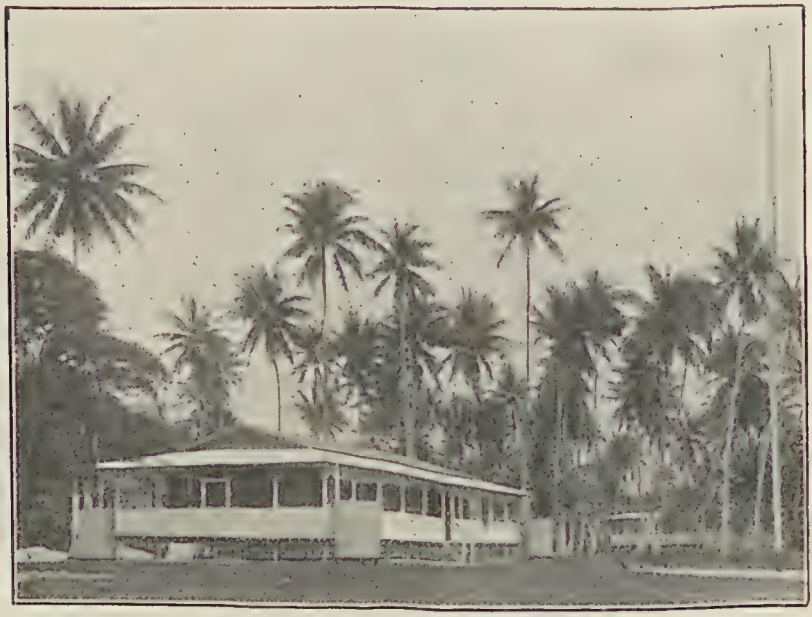
From this out (November, 1914) Nauru continued to be held and garrisoned by Australian soldiers. It was maintained at the Peace Conference that Australia had occupied Nauru on behalf of the Imperial Government, and that her claims could not be held to nullify others. The Australian Prime Minister insisted, however, that the Commonwealth's just claim must be recognised. On top of this, our friends in the Dominion of New Zealand lodged a claim on the ground of proximity and New Zealand's need of guaranteed supplies of phosphate for future years. After a strenuous fight by Mr. Hughes for the recognition of Australia's claims, an agreement was arrived at by which the three Governments were to participate jointly in the Nauru deposits, and also to incorporate the Ocean Island deposits in the scheme.

The price paid by the three Governments (Britain, Australia, and New Zealand) was £3,500,000, in the proportions of 42 per cent., 42 per cent., and 16 per cent., respectively, and now that the facts have been placed before them, Australians will fully realize what the ownership of more than one-third of the wonderful deposits on these two islands will mean to them and to future generations of Australians. The sum of £3,500,000 was paid, not only for the Pacific Phosphate Company's right, title, and interest, but also for the plant on both islands. It has been calculated that the replacement of the very extensive plants on these islands would take, at present-day prices, a considerable proportion of the sum paid as the purchase price.

Under the terms of the *Nauru Island Agreement Act* 1919, each of the countries named therein is entitled to an allotment of the following proportion of the phosphate produced in any one year, viz.:—

United Kingdom	42 per cent.
Australia	42 per cent.
New Zealand	16 per cent.

These allotments are for home consumption for agricultural purposes in the country of allotment, and not for export. The basis of allotment is to be readjusted every five years, in accordance with the actual requirements of each country. If in any one year one of the three countries does not require portion of its allotment, the other two countries are entitled, so far as their requirements for home consumption extend, to have that portion allotted among themselves in the proportions to which they are entitled as above. And here it might be mentioned that, owing to Great Britain not requiring her full quota this year, Australia, instead of being allotted 168,000 tons, will receive a little over 200,000 tons out of the total quantity of 400,000 tons which, it is anticipated, will be shipped. Up to the present the best year's figures are those for 1913, when a total quantity of practically 350,000 tons was loaded.



Flag-staff and General Office at Nauru before latter was enlarged.

Control.

The business is now vested in a Board of Commissioners, comprising three members—one appointed by each Government—the writer being appointed by the Commonwealth Government, Mr. A. R. Dickinson by the British Government, and Mr. A. F. Ellis by the New Zealand Government. The Commission took over the business on the 1st July, 1920, and the central office of management is at 465 Collins-street, Melbourne.

Water Supply, &c., &c., of Nauru.

There is a big condensing plant on the island. With a large number of coloured labourers, working mostly in the sun, it is of paramount importance that there should always be a plentiful supply of good, fresh water on hand. As condensing means consumption of coal, which is

difficult and costly to handle, every effort possible has been made to conserve the rain water. Adjacent to every good, clean roof a large reinforced concrete underground cistern has been built. Consequently, when these are full there are hundreds of thousands of gallons of water in reserve. Long before this supply gives out condensing is commenced.

Practically all the power used on the island is electric, generated in the power-house. Here there are four or five internal combustion engines of the Diesel type, aggregating from 800 to 1,000 horse-power. The fuel used is crude oil, taken up from Australia in drums. The settlement is well lit throughout with electric light, the mains being placed underground. In the power-house is the telephone exchange, operated by a kanaka boy (all kanakas are called "boys"), and connecting up the various departments, Government, and wireless stations.

There is a well-equipped refrigerating plant, from which ice is supplied daily to the married members of the staff and to the single

Nauru: Field with overburden removed and ready for working, also Covered-in Area.

men dining in the mess-room. Cattle and sheep are taken up alive from Sydney, slaughtered on the island, and then put into the refrigerating chambers. The steward issues fresh meat three or four times a week.

In the hospital enclosure are two large hospitals, one each for kanakas and Chinese, and another, not quite so large, used as an isolation ward for both. In the same enclosure, in addition to the three hospitals mentioned, is the dispensary, surgery, and operating theatre in one building. Outside the hospital compound, but quite close to it, is the doctor's residence and white staff cottage hospital.

An excellent sewerage system is in use throughout the entire settlement. As flushing with fresh water would be too wasteful, a salt-water service has been installed for the purpose. This service was extended, and salt water, as well as fresh water, is available in every bathroom.

Working Operations.

As already stated, the phosphate deposits are situated in the central, elevated, and uninhabited portion of the island. Before commencing to work a field, the trees are valued, paid for, and cut down. The undergrowth is then collected into heaps, left a few days, and then burnt. After this the overburden, consisting of coarse grass, and the top 2 or 3 inches of weather-stained phosphate, is removed. The field is then ready for working. Light 2-ft. gauge railways, branching off the main line, are run into the new field. The phosphate trucks, which are the patent side-tipping 1-ton capacity type, are pushed on to this line, and the Chinese coolies, each using two carry-baskets, proceed to fill them. The coolies are divided into two gangs: one digging out the phosphate and filling the baskets, the other carrying them. In

Nauru: Phosphate Storage Bin on the "Flat." (Note how provision is made for "rakes" of trucks going under floor of bin.)

the phosphate fields and on the upper levels steam locomotives are used. These ply along the main lines and collect from the fields on each side "rakes" of trucks as they become ready. The trains are then taken to the dryer plants, where the trucks are tipped from a gallery into the top of the "wet" bins. Through doors in the floor of these bins the phosphate gravitates to the rock crushers (which crush any pieces of rock to, say, the size of a walnut), and thence into the dryers.

The dryers are large rotary cylinders about 60 feet long, tapering slightly from the furnace end, and having the inside surface set with vanes. As the cylinder revolves these vanes turn the phosphate over and over, completely exposing every particle to the terrific heat, and at the same time precipitating it towards the outlet end. Having travelled along the whole length of the cylinder, the phosphate, by this time so hot that it cannot be touched with the hand, falls through an aperture on to a steel band conveyor, by which it is carried to and

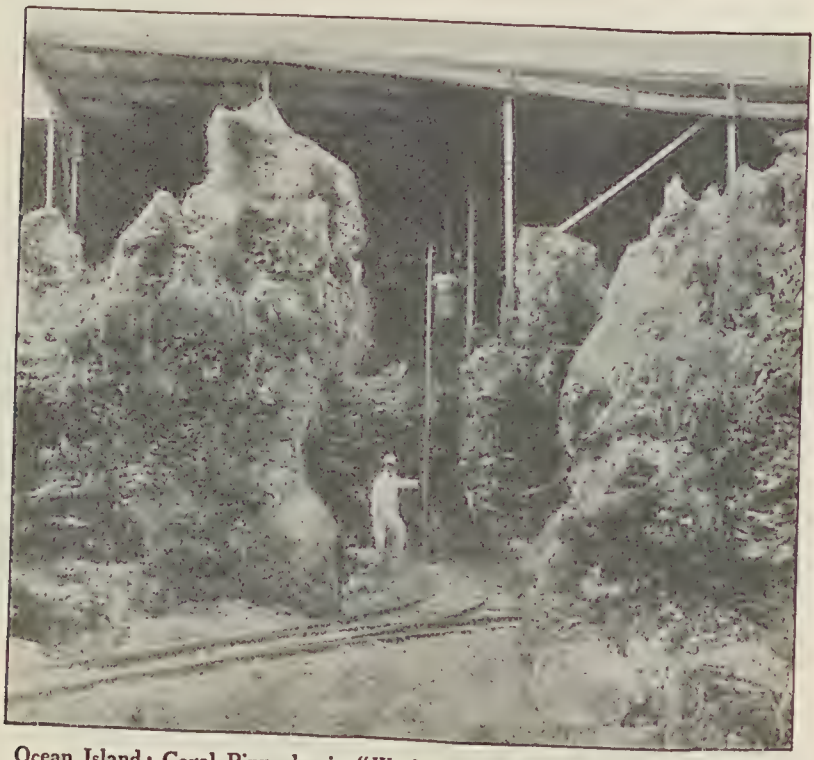
delivered into the tops of the large storage bins, where it is ready for shipment.

The trains on the "flat" (the atoll portion of the island) are electric, and are run under the concrete floors of the storage bins, which are fitted at frequent intervals with hopper doors. On a truck coming down under one of these doors, a lever is pulled, and it is filled in a few seconds. As soon as a train load is ready, the electric locomotive hauls it to whichever jetty is shipping. At the jetty end there is a hopper holding about 2½ tons, or one lighter load, into which the phosphate is tipped. On a staging erected under the jetty decking a "boy" stands operating a lever. As soon as the lighter is in position under the shoot this lever is pulled, and a door at the bottom of the hopper is opened, through which the phosphate falls into the shoot. Attached to the end of the shoot is a flexible nozzle, by means of which

Nauru: Railway Line through part of a "Worked-out" Field.

the boys in the lighter below direct the phosphate into the four large baskets, which each boat carries. Some, however, carry six baskets. A four-basket boat when loaded holds about 2½ tons of phosphate, and a six-basket boat about half as much again. Motor launches then tow the lighters to the ship's side. The baskets are hauled up, one at a time, by the ship's tackle, and swung inboard over the hatch, which is closed, except for a narrow opening in the centre, across which a tipping block is placed. Stationed here are two boys, whose duty it is to steady the swaying basket in order that, when lowered, it may fall squarely on the block. This done, it immediately capsizes, emptying its contents into the opening mentioned. In this manner 1,300 tons have been loaded in one day to a single ship, and, working two shifts, as much as 2,000 tons a day has been loaded by one vessel. At night electric flood-lights are used. The most suitable ships to load are those with no 'tween decks where no trimming is required.

The modern steel cantilever jetties have an overhang reaching out beyond the outer edge of the reef to a distance of 70 feet. On the edge of the reef the water is usually broken, and the advantage afforded to the lighters in being able to remain in the unbroken and comparatively still water, while the baskets are being filled, is enormous. The end of each jetty is furnished with a steam or electric winch and a good, strong derrick. When a ship is discharging her inward cargo of stores, &c., the goods are lowered over the side into the boats, which are later on used for loading. The boats when filled are towed to the jetty end, where the contents are hauled up, placed on trucks, and run away to the various stores.



Ocean Island: Coral Pinnacles in "Worked-out" Field and Covered-in Area.

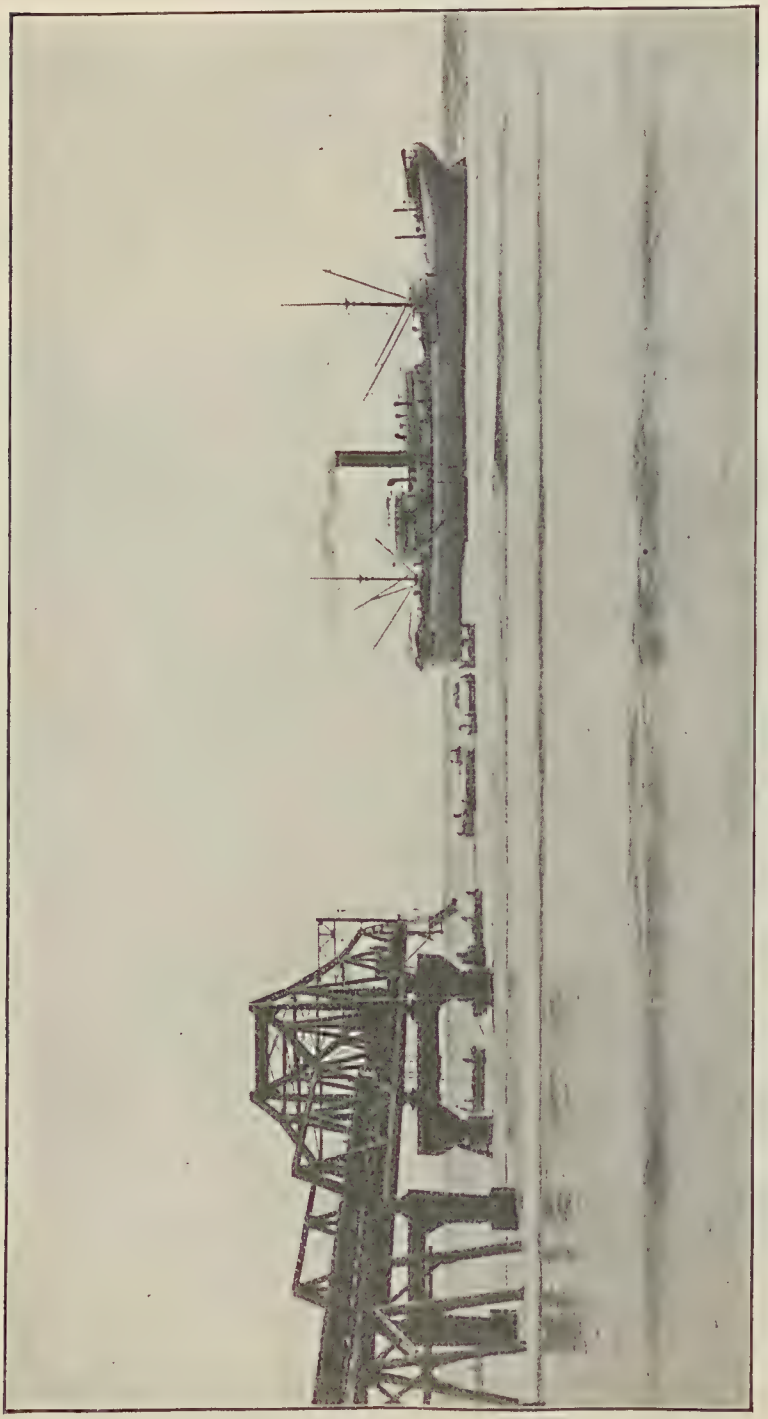
The moorings to which the ships make fast are the largest and deepest in the world, and a great deal of arduous and dangerous work is necessitated in the laying of them. They are laid by a New Zealander—Mr. G. W. W. Cozens, of Auckland—who is an expert in these matters. The main buoy of each set of moorings is about a couple of ships' lengths from the shore, with the outer anchor lying in about 200 fathoms of water—nearly a quarter of a mile deep. The moorings are very efficient, being easily approached and made fast to and readily "slipped" if, in squally weather, it is necessary for a vessel to put hurriedly to sea. The amount that these excellent moorings have contributed towards the success of the loading operations at both islands can hardly be over-estimated.

OCEAN ISLAND.

Ocean Island, the native name of which is Banaba, was discovered by the British ship *Ocean* in 1804. For many years past it has been

Nauru: A corner of a particularly Good Field, showing portion of one of the covered-in areas, which are used for working under in wet weather.

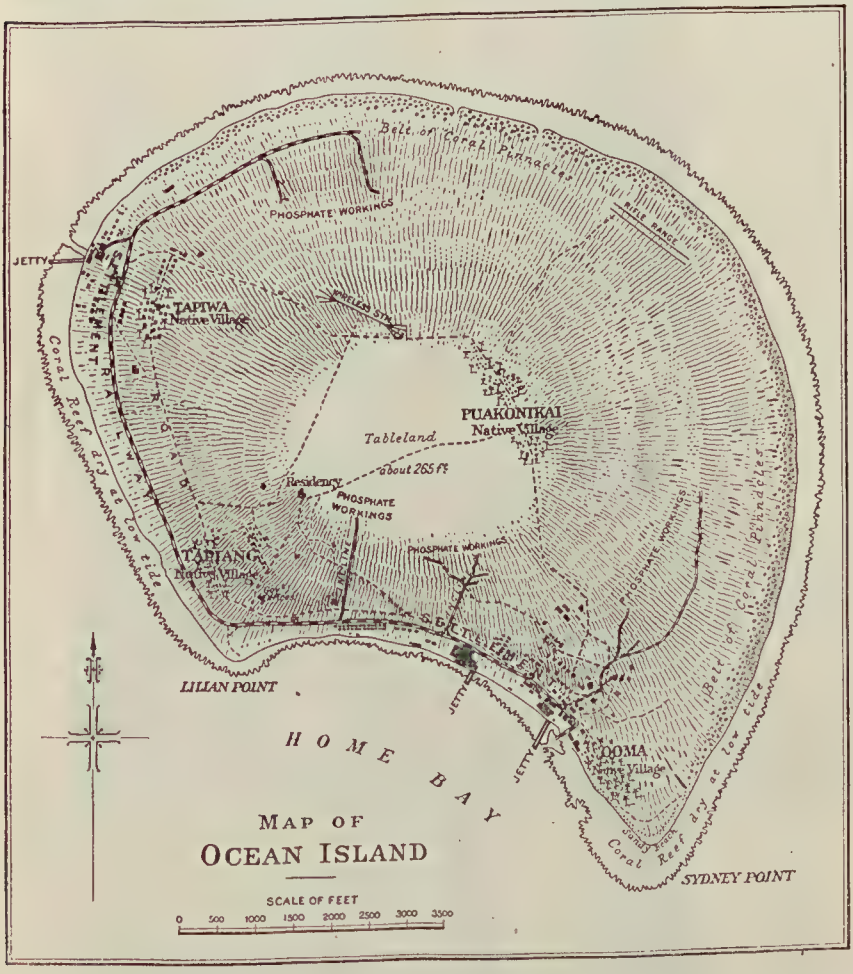
the seat of Government for the Crown Colony of the Gilbert and Ellice Islands. Though it is only about one-third the size of Nauru, its phosphate deposits, as already stated, are wonderfully rich. The shape



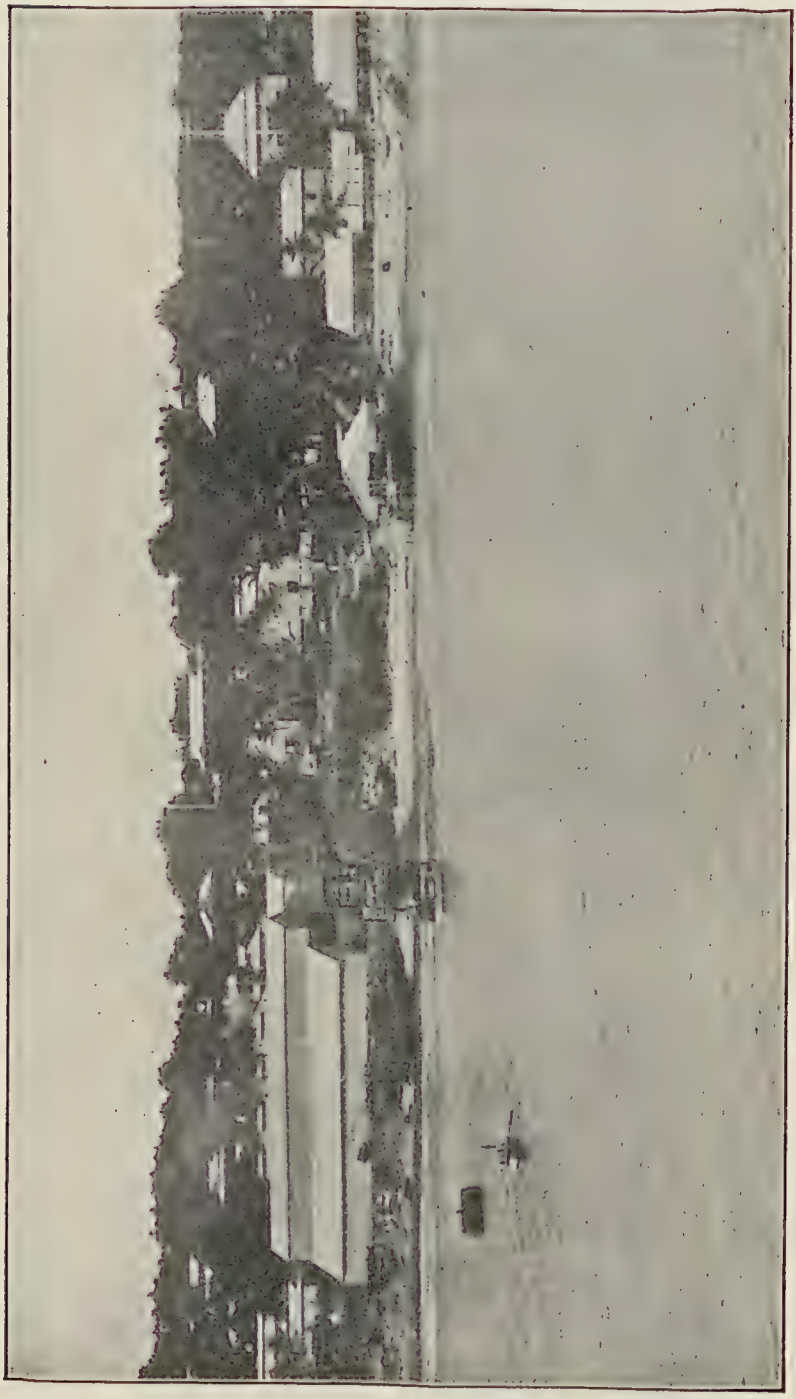
Nauru: A vessel loading 6,000 tons for Australia. (Over 1,200 tons were shipped to the steamer shown from one jetty the day this photo was taken.)

of the island has frequently been compared to that of a pearl shell, the one large indentation being called Home Bay. Like Nauru, Ocean Island has the usual fringing reef, but once that is crossed the land rises more or less abruptly to an altitude of about 265 feet above sea-level. There are two white settlements—Uma (Ooma) and Tabwewa (Tapiwa).

The natives, who are an off-shoot from the Gilbert Islanders, are friendly and intelligent, though not so good looking as the Nauruans.

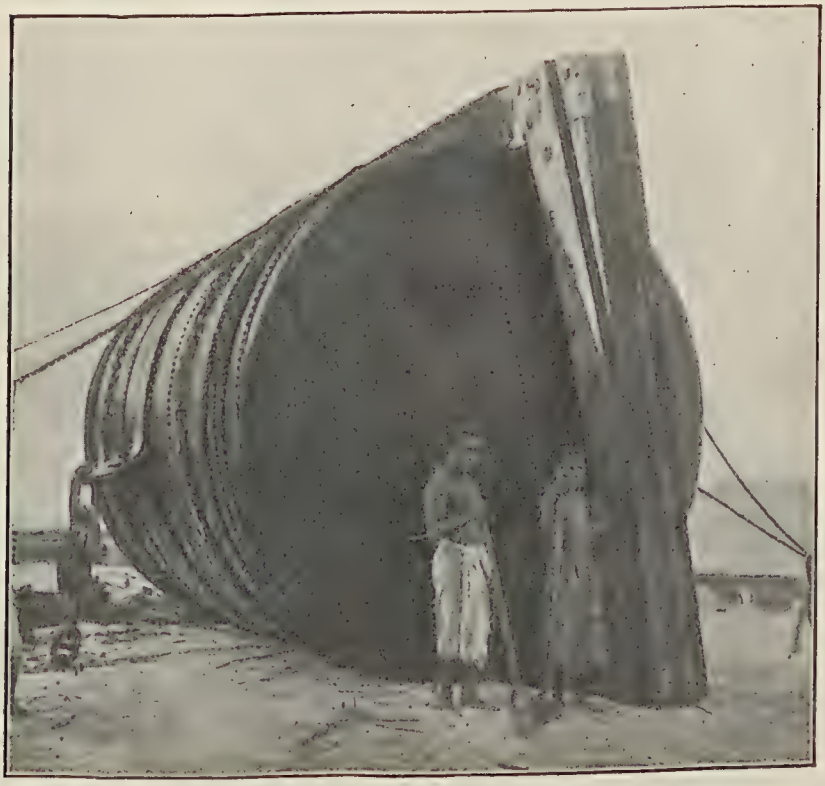


Doubtless the hard struggle the Ocean Islanders had, up to the time of the advent of the Pacific Phosphate Company in 1900, is responsible for this. Except for a very limited area near Sydney Point, there is no place on Ocean Island where the coco-nut trees can grow in the sand and get their roots down to the saltish water percolating in from the sea. The result is that, compared with Nauru, the coco-nut trees on Ocean Island are poor and stunted, entirely depending as they are upon the rainfall, which, however plentiful, soon soaks deeper down than, and away from, the roots. The droughts of past years are



Ocean Island: View of part of Ooma Settlement from Ship at Moorings.

plainly indicated in the pinched portions along the trunks of the trees. The crop of nuts frequently gave out, and the natives were, in consequence, hard put to it to eke out a miserable existence. They depended at such times as these almost solely upon fishing for a livelihood, with a result that they gained, and have kept, the reputation of being the finest fishermen in the Pacific. The indigenous population now numbers only about 450. There is evidence, however, by the ruins of native villages, that the island must, at one time, have carried a much larger number.



Ocean Island: One of the Large Buoys used for supporting vertical portion of main moorings.

GENERAL.

Both islands have tennis courts, cricket pitches, recreation rooms with billiard-tables, and libraries, theatres, and picture shows.

Practically all that has been written here regarding the works and operations on Nauru is applicable to Ocean Island also.

Finally, there can be no doubt that in owning more than one-third of the deposits on Nauru and Ocean Island, Australia has a wonderful asset. The demand for phosphate is rapidly increasing all over the world, and it is gratifying to know that an agricultural country like ours is now assured of its phosphate requirements, however quickly the demand may rise, for a great many years to come.

RUPANYUP CROP AND FALLOW COMPETITION.

Report of Judge H. A. Mullett, B.Ag.Sc., Chief Field Officer.

The competition at Rupanyup this year must be pronounced an unqualified success, as the crops were everywhere good, the entry a record one, and rivalry keen. From the point of view of adding to the common fund of knowledge as to the best farming practices in the district, valuable information has been gained. That is to say, the true object of the competition has been well served.

THE DISTRICTS.

The Rupanyup district, comprising as it does such large areas of rich black soil of even fertility, is one in which, for the most part, the comparative yields of the crops when taken over a series of years are a reliable indication of the skill of those who produce them. Reliable deductions from the competition can therefore be made.

Some of the most fertile land in the Wimmera is to be found in the celebrated Lallat Plain, upon which many of the competitors reside. Once a waterless, treeless belt, supporting but a few sheep, to-day it is dotted with up-to-date homesteads well planted with windbreaks of sugar-gums. A notable feature of the district is the excellent type of farm out-buildings that have been erected.

There is almost a complete absence of those tumble-down straw-roofed structures that remain as relics of the pioneering days to mar many of the Wimmera landscapes.

The whole of the soil in the district is, however, not black In the direction of Marnoo and to the south stiff red soils are met with. They are not nearly so fertile, nor so easily managed as the black. Where competitors exhibited crops on red soil, a small handicap has been allowed in accordance with the society's rules.

The Competition, 1920.

In all, a total of 60 entries was judged in the three sections comprising the competition. In the whole of the eleven districts in which similar competitions were held this year, this number was only exceeded in one case, that of Nhill, where the total comprised 64—a record for the Wimmera for any year.

The three sections comprise—No. 1, the "Brunton Cup," for which a handsome silver cup has been donated by Messrs. Brunton and Co., flour millers; No. 2, for "best 60 acres of wheat"; and No. 3, for the "best fallowed land."

For the Brunton Cup the whole of each competitor's wheat crop for an aggregate of three years must be judged. This is the initial year. In section 3, 50 per cent. of each competitor's fallow must be judged.

RESULTS.—BRUNTON CUP.

In the Brunton Cup competition, R. T. Jackson was placed first with 97 points out of a possible 100; W. J. Hemphill second with 91; and G. H. Hemphill third with 90. Geo. Chapman and Bell Bros. were next in order of merit. The prize is, however, awarded on the aggregate of points for three years. The results during the next two

years may materially alter the positions of the competitors. In any case, an interesting struggle may be expected.

Mr. Jackson's crop was an exceedingly heavy one; out of some 23,000 acres of wheat inspected in seven Wimmera districts this year this was the best crop for its size seen.

It comprised a total of 265 acres of wheat, mainly of the Federation variety; 20 acres, however, were of that promising new variety known as Huff's Imperial. Every acre of wheat on this farm was a show one. The crop was surprisingly even and dense throughout, it was free from wild oats, clean under foot, and free from disease. One hundred acres were grown on summer fallow, and the balance on winter fallow. In accordance with the general experience in the Wimmera, the heaviest portion of this crop was that on the summer-fallowed land. The land was fallowed with the plough to 3 inches in March, and then harrowed twice. Early in September it was scarified, and harrowed twice immediately after. Subsequently it was harrowed at the end of

The Winning Crop of Federation, averaging, for 265 acres, 43 bushels per acre. (R. J. Jackson, Rupanyup.)

October, then harrowed after the first rain following the harvest, and finally scarified and drilled and harrowed from 5th June to the second week in June. Eighty lbs. of seed were used, and 90 lbs. of superphosphate. It is Mr. Jackson's usual practice to scarify the fallow twice in the spring and twice before sowing.

Owing to the dry weather it was not desired to disturb the fallow deeply, therefore, the harrows were used instead of scarifier. It is significant that in other Wimmera districts the heaviest crops in the competitions were often those where the use of the scarifier had been temporarily dispensed with. To his judgment in this respect, and to the use of liberal dressings of seed and manure, Mr. Jackson probably owes his successful crop. The use of light implements on the fallow in a dry year will be discussed in detail later.

Mr. W. J. Hemphill also exhibited an excellent crop of Federation. The area sown comprised 131 acres (only about half of that of the first competitor). The whole of the land had been summer-fallowed.

The heaviest portion of the crop was sown on land ploughed early in April, scarified in August, and again in November. Subsequently it was again harrowed and scarified in April, and finally scarified before the drill. Seventy lbs. of seed were used, and 112 lbs. of superphosphate. The sowing took place at the end of June. This crop was very even, the wheat was of good type. A little Take-all was present.

Mr. G. H. Hemphill's crop consisted of 183 acres of Federation. The heaviest portion, 75 acres, was sown on summer-fallowed land. The scarifier was sparingly used, and harrows substituted. Seventy lbs. of seed and 112 lbs. of superphosphate were used. Black rust was noticeable.

Mr. Geo. Chapman showed some heavy crop, mainly of the Federation variety. Small areas of Major and Majestic were also included. Portion was on summer-fallowed land, and portion on winter-fallowed land. The main paddock had been cropped heavily for a number of years, and Flag-rust and Take-all were in evidence. Mr. Chapman uses from 75 to 80 lbs. of seed and 100 lbs. of manure.

Most of the other crops had special points of interest, but none more than the crop shown by Mr. James Chapman. A fence separated two paddocks, in which the yields differed by a good five bags to the acre. Take-all was responsible for the lowering of the yield, yet the infested paddock had just previously grown a crop of oats. The history and treatment of the two paddocks is set out in parallel columns:—

75 Acres. Take-all infested.	
1918–19 ..	.. Oats.
1919–20 ..	.. Winter fallow.
1920–21 ..	.. Wheat, 7 bags (take-all infested).

45 Acres. Heavy Crop.	
1916–17 ..	.. Oats.
1917–18 ..	.. Fallow.
1918–19 ..	.. Wheat.
1919–20 ..	.. Summer fallow.
1920–21 ..	.. Wheat, 12½ bags (clean).

The 75 acres of winter fallow, upon which the infested crop was grown, was treated as follows:—Ploughed in July and August, harrowed early in September, scarified second week in October. In January, the paddock was harrowed. At the end of May it was scarified, and then re-scarified and drilled. It was harrowed after the drill. Seeding took place from 18th June to 1st July. Seventy-five lbs. of Federation wheat were used, and 112 lbs. of superphosphate. It will be noted that this fallow had been well worked with heavy implements. The summer-fallowed paddock was ploughed at the end of February, then harrowed well in June, skin-ploughed early in July, and harrowed in September. Early in October it was scarified, and then harrowed in January. Only one scarifying was given before seeding early in June. The paddock was then harrowed. Seventy-five lbs. of seed were used, and 112 lbs. of superphosphate. Assuming that both paddocks were infested with Take-all prior to seeding the crop, the main difference in the treatment lies in the sparing use of the heavy implements on the summer fallow. In view of the importance that the best Wimmera farmers attach to good consolidation of the fallow as a Take-all eradicator, the results, to say the least, are significant. The stubbles of the winter-fallowed land were very loose at harvest time.

Section 1.—Brunton Cup.

Best wheat crop, not less than 100 acres. The whole of the competitors' wheat to be judged. Silver cup for best aggregate of points for three years 1920-21, 1921-22, 1922-23.

Name.	Yield.	Trueness to Type.	Disease.	Weeds.	Evenness.	Handicap for Red Patches.	Total.
Possible Points ..	**35**	**20**	**15**	**15**	**15**	..	**100**
R. J. Jackson ..	35	19	14	15	14	..	97
W. J. Hemphill ..	34	18	12	14	13	..	91
G. H. Hemphill ..	33	18	12	12	15	..	90
Geo. Chapman ..	32	17	12	13	13	..	87
Bell Bros. ..	31	17	10	14	14	..	86
Carra Bros. ..	28	19	11	14	14	..	86
C. Carra ..	26	19	10	14	13	..	82
J. C. Hutchings ..	31	18	8	12	13	..	82
H. Holkamp ..	29	17	11	13	12	..	82
G. W. Ellard ..	31	13	11	12	14	..	81
A. Dunlop ..	27	16	10	13	15	..	81
Jas. Crampton ..	30	17	9	12	13	..	81
A. McKinnon ..	26	18	12	10	12	3	81
R. Hurley ..	32	15	6	13	15	..	81
James Chapman ..	27	19	9	12	12	..	79
W. H. Kendall ..	26	17	9	10	12	3	77
D. B. Payne ..	28	15	8	12	13	..	76
H. Duncan ..	25	17	10	11	12	..	75
C. A. Graham ..	25	20	9	9	11	1	75
C. Culton ..	23	18	13	8	12	..	74
Miller Bros. ..	24	17	11	8	11	..	71
G. Kennedy ..	26	18	8	8	10	..	70
A. Crommie ..	25	14	6	11	12	..	68
J. T. Sweetman ..	24	10	6	11	11	..	62
A. Schaper ..	18	17	6	7	8	1	57

RESULTS.—SECTION 2.

Best 60 Acres of Wheat.

In this section, where the competitors were required to show smaller areas, some remarkably heavy crops were exhibited by Messrs. R. J. Jackson, E. Aumann, and Bell Bros., who were placed first, second, and third, in that order respectively. It would be difficult to exaggerate the yields of either of the paddocks of 60 acres shown by R. J. Jackson and Bell Bros. They are the heaviest crops of wheat I have had the pleasure of judging in the Wimmera. Their density may be gauged when it is stated that some considerable effort was necessary to walk through them. Each of the crops was of the Federation variety. That of Mr. Jackson was practically true to type, free from disease and weeds, and exceptionally even. The method by which this crop was grown has already been outlined.

Mr. E. Aumann's crop of Federation was also a heavy one, but a few points were deducted for the presence of strangers. This crop was also grown on summer fallow. The ground was ploughed in February and March to 3 inches deep. At the end of July it was scarified and

then harrowed. At the end of September it was scarified very lightly, a special blade being fitted to the back of the scarifier for the purpose of cutting rubbish. The object was to kill the weeds and yet avoid stirring the soil deeply—a wise precaution, in such a dry year. Later it was harrowed before harvest. After harvest it was harrowed lightly immediately after rain. In June the paddock was scarified up, then part re-scarified where weeds were bad, and the rest harrowed only. It was then drilled and harrowed; 70 lbs. of seed were used and 75 lbs. superphosphate per acre. Like Mr. Jackson, Mr. Aumann probably owes a considerable portion of the success of the crop to skill in maintaining a shallow tilth on his fallow during the dry spell last year. Mr. Aumann's device of attaching a blade to the scarifier to cut weeds, and yet maintained at a shallow depth of tilth, is the one that will instantly commend itself to Wimmera farmers, who have not used it.

Messrs. Bell Bros.' crop of Federation variety was also grown on summer fallow land. The harrows were kept going after harvest, because the land was cracking. Seeding took place from 10th June to 20th July; 70 lbs. of wheat were used and 90 lbs. of manure.

Mr. A. Dunlop's Farmstead, Rupanyup.

J. C. Hutchings' crop of Federation was also heavy; points were deducted for the presence of a little smut. The method used in the preparation of the fallow on which this crop was grown was interesting, because the usual spring working of the scarifier had been dispensed with altogether and replaced with sheep and harrows. This was a special precaution, taken to insure consolidation on account of the dry spring.

The paddock was ploughed to 4 inches in July and August; subsequently it was harrowed no less than six times after rain, and well sheeped. No scarifier was used until just before the drilling in June and July; 70 lbs. of seed were used and 100 lbs. of superphosphate. Though this farm has been cropped on the fallow-wheat-oats system for eight or nine years, a portion of the crop sown in May was affected with Take-all.

Details.—Section 2.

Best 60 Acres Wheat.

Name.	Yield	Trueness to Type.	Disease.	Weeds.	Evenness.	Handicap for Red Patches.	Total.
Possible Points ..	**35**	**20**	**15**	**15**	**15**	..	**100**
R. J. Jackson (No. 1)	35	19	15	14	15	..	98
E. Aumann ..	33	16	15	14	15	..	93
Bell Bros. ..	35	17	10	15	15	..	92
Carra Bros. ..	26	19	13	14	15	..	87
R. J. Jackson (No. 2	28	17	12	15	15	..	87
J. C. Hutchings ..	30	18	10	14	14	..	86
D. N. McLennan ..	25	19	14	14	12	1	85
A. J. Oram ..	23	19	12	15	15	..	84
W. J. Hemphill ..	25	18	12	13	14	..	82
Geo. Chapman ..	26	17	12	14	13	..	82
H. Holkamp ..	23	17	14	14	12	..	80
Jas. Crampton ..	24	16	12	13	12	..	77
D. B. Payne ..	27	15	8	13	14	..	77
C. Carra ..	18	19	10	14	13	..	74
C. Culton ..	14	19	13	14	14	..	74
A. Dunlop ..	17	16	11	14	15	..	73
Jas. Chapman ..	22	19	10	11	11	..	73
Geo. Kennedy ..	23	18	12	8	12	..	73
G. Campbell ..	23	13	9	14	13	..	72
Miller Bros. ..	17	18	12	10	12	..	69
C. A. Graham ..	17	20	9	12	11	..	69
W. H. Kendall ..	18	17	9	10	12	2	68
R. Duncan ..	17	17	10	10	12	..	66
J. T. Sweetman ..	18	14	8	12	12	..	64
Brown Bros. ..	Withdrawn.						

Note.—As 35 per cent. of the marks is allotted for yield only, the points awarded in this case do not represent bushels per acre. As far as possible the differences between them do. The yields of the first few crops were much higher than 35 bushels per acre.

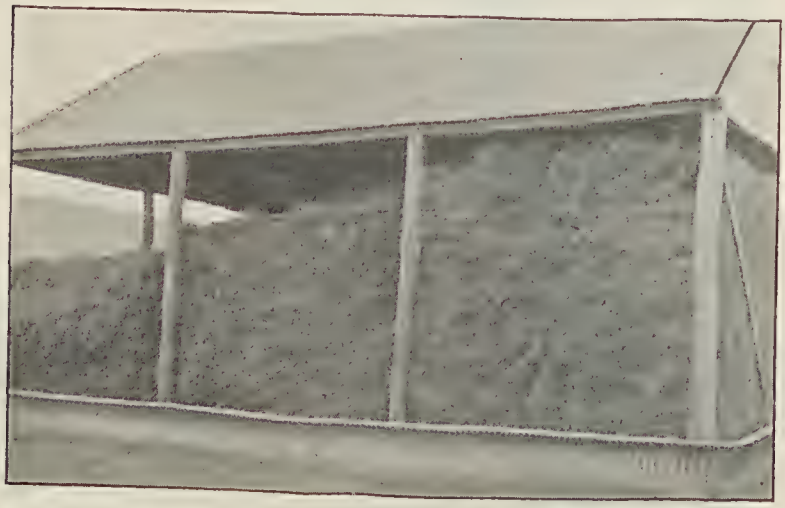
RESULTS.—SECTION 3.

Best Fallowed Land, 50 per cent. of fallow to be shown.

The winning fallow was that of W. J. Hemphill, with 97 points. J. T. Sweetman was second, with 93, and A. J. Oram third, with 92.

Mr. Hemphill's fallow was in two paddocks of 90 acres and 130 acres respectively. Both were summer fallow. The moisture content was high, the dust mulch a good 2½ inches deep overlying a well-defined, firm bottom. The cultivation had been well done, the implements tracking at an even depth. The best portion was ploughed to 4 inches deep in March, scarified at the end of July, re-scarified in October, and then harrowed.

The best portion of Mr. Sweetman's fallow was summer fallow that was exceptionally well worked. The moisture conserved and consolidation were good. Points were lost for the character of the mulch.



A Well-Protected Stack. (Note mouse-proof enclosure of curved, corrugated iron.)

DETAILS.—SECTION 3.

For best fallowed land—50 per cent. of exhibitors' fallow to be judged.

Name.	Moisture.	Mulch.	Weeds.	Cultivation.	Total.
Possible Points	25	25	25	25	100
W. J. Hemphill	25	25	22	25	97
J. T. Sweetman	22	23	25	23	93
A. J. Oram	23	22	24	23	92
C. Carra	21	22	25	23	91
R. J. Jackson	23	21	22	24	90
C. Culton	22	21	24	23	90
W. H. Kendall	22	23	25	19	89
D. N. McLennan	19	22	22	23	86
A. Dunlop	19	21	25	21	86
G. Kennedy	20	17	21	16	74
A. Crommie	19	17	22	16	74

LESSONS FROM THE COMPETITION.

Working the Fallow in a Dry Year.

Observant Wimmera farmers have long come to associate loose, badly-consolidated fallow with poor crop. In the average year the art of fallowing the friable black-soil resolves itself into killing weeds and conserving the moisture by preserving the surface mulch and yet maintaining the soil below 2½ inches deep in a well consolidated state. The less skilled obtain the result by ploughing as shallowly as possible, and thereby, for an immediate gain, place a tremendous strain on the top two or three inches of the soil.

The more skilled, however, plough deeper—to 4 and even 5 inches if the subsoil will permit—and effect the consolidation by the exercise of profound judgment in the use of the various implements and the sheep. When the season is wet there is no trouble, and the under layers run together naturally. On the other hand, when the rain is scanty it is only by special treatment that the particles of soil can be made to adhere. The continued use of the scarifier on such deeply-ploughed soil is

Oil Tractor Drawing Reaper-Thresher. (Mr. W. H. Kendall, Rupanyup.)

fatal. It wallows to the full depth of the ploughing, and a loose, open fallow is the result. Then the harrows must be substituted and then only used immediately after any fall of rain. Their use must not be persisted in when the soil dries out. Many farmers keep a set of harrows for each paddock, with chains attached, ready for work at the shortest notice. The largest sets possible are used. Should the early harrowing not kill the weeds while still tiny seedlings, the spring-toothed cultivator may have to be employed. The paddock should be well sheeped. The more they tramp it the better. If the scarifier must be used, then the use of such a device as that adopted by Mr. E. Aumann is most desirable. The blade attached to the scarifier will cut all weeds, and at the same time permit of the shallowest cultivation.

The outstanding success of the crops grown on fallows that had been worked with light implements, such as harrows, during the dry spell where the scarifier had been temporarily dispensed with and where the fallow had been well sheeped, is one of the features of the competition this year, not only at Rupanyup, but throughout the Wimmera. It is a lesson that might well be taken to heart.

Summer Fallow.

The competitions in Rupanyup, and everywhere else in the Wimmera, were also a signal triumph for the summer-fallowed land. The almost monotonous regularity with which crops grown on summer fallow won the various competitions is a signal demonstration of its value to Wimmera farmers. It is estimated that a crop grown on well-prepared summer fallow will yield from one to two bags better than one grown on winter fallow.

The summer fallow, affording as it does the opportunity for coping with weeds over so long a period, lends itself to the establishment of good consolidation in a dry year. The weeds being destroyed early, the remainder of the work may be effected with harrows. Instead of re-scarifying before seeding, the crop may, with advantage, be put in with the combined drill cultivator. That was the treatment given the winning crop of Mr. A. H. Krelle, at Minyip.

Seed and Manure.

Since the start of the competitions at Rupanyup three years ago, a marked improvement in the type of wheat grown is noticeable. This result can be ascribed to the competition. This year, by means of a co-operative effort, the Rupanyup Agricultural Society ordered, in one lot, no less than 350 bags of pedigree seed wheat from Longerenong College Seed Station. An increase in the amount of seed used per acre is also noticeable. That has rightly been accompanied by heavier dressings of superphosphate; 75 to 80 lbs. of seed with 112 of super. on well-worked fallow should be the standard aimed at.

. . . . . .

In conclusion, I have to thank members of the Society, and particularly Mr. Chapman, the Secretary, to whom the success of the competition is largely due, for courteous assistance during the work of judging.

THE AGE OF GUM TREES.

A subscriber has asked for information regarding the probable age of the oldest eucalyptus trees in Victorian forests, and the Botanical Assistant of the Department of Agriculture furnishes the following reply:—"Diligent search in the available literature has revealed an estimate by Professor Langethal, who believed a Tasmanian giant of *Eucalyptus globulus* to have lived 2,300 years. Mueller, however, in his *Eucalyptographia* (see subject: Euc. Globulus), pronounces that estimate erroneous, but wisely, and with his customary caution, refrains from giving an estimate himself. I cannot help thinking that, if the Sequoias of the Yosemite, which have a remarkably shallow root-system, have endured individually for thousands of years, some of our own gums, with their deep-going roots, must surely have weathered the storms of life at least as well as their coniferous cousins in California."

EXPERIMENTAL WORK IN WESTERN DISTRICT.

RESULTS FOR SEASON 1920.

H. A. Mullett, B.Ag.Sc., Chief Field Officer, Department of Agriculture.

The experimental plots in the Western District, which had been abandoned owing to causes arising out of the war, were resumed in 1920, though the original plan was greatly modified. The plots now comprise—

1. Manurial tests with oats and variety tests with wheat	Cavendish, Strathkellar, Lismore, Streatham.
2. Manurial and variety tests with wheat	Willaura.
3. Topdressing tests on natural pastures	Hamilton and Glenthompson.

For the present it is proposed to refer only to the experiments with cereals. The pastures will be dealt with in a subsequent article.

THE DISTRICT.

The area covered by the plots is the northern portion of the Western District. The average annual rainfall in this part of the Western District ranges from about 19½ inches at Willaura to 27 inches at Strathkellar.

Lismore and Streatham are situated on the volcanic plain. The soil there is a cold clay. At Willaura some of the country has been derived from sandstones as well. The Willaura soils are mainly light sandy loams and silts, with buckshot.

At Cavendish the plots are on a silty soil of sedimentary origin. Here there is a relatively impervious cementy layer at about 7 or 8 inches. At Strathkellar the soil is a good black volcanic one.

OBJECTS OF TESTS.

The main object of the tests is to determine the manurial requirements of the staple cereal of the district—Algerian oats. An attempt is also being made to discover which of a number of wheat varieties is the most suitable for the district. In addition, several forages, such as lucerne, Wimmera rye grass, and subterranean clover, are being given a trial.

At Willaura the manurial tests were conducted with Federation wheat intead of oats.

In the manurial trials special interest was centred in the tests with basic phosphate as against superphosphate. Basic phosphate is a manure prepared by the addition of a small proportion of lime to superphosphate during manufacture. It is designed to take the place of Thomas' phosphate, which was unobtainable during the war. It

had been claimed for the special soils of the Western District, containing, as many of them do, ironstone, that manure of a basic type is superior to superphosphate. The results of the trials, so far as they go, appear to show that it is not safe to generalize with regard to the type of manure most profitable to apply, and that it varies with the district. In four out of five centres superphosphate gave the better results.

RESULTS.

Oats.

At Strathkellar, Lismore, and Cavendish the oats were sown on stubble land, and at Streatham on fallow. The response to the manures was good. At Strathkellar on good land the yields reached as high as 77 bushels per acre. The results at Cavendish, however, were much below that.

At Streatham there were losses on some of the plots, due to a wind storm at harvest time. The plots ripest at the time, *i.e.*, plots dressed with superphosphate suffered most. At this centre bonedust and basic phosphate being unprocurable, were not sown.

TABLE SHOWING YIELDS OBTAINED FROM OAT PLOTS.

Each plot about $\frac{3}{8}$ acre. Algerian oats sown at $1\frac{1}{2}$ bushels per acre. Sown second to third week in May, 1920.

Manurial Treatment.	District.			
	Strathkellar.	Lismore.	Cavendish.	Streatham.
	Bushels per acre.	Bushels per acre.	Bushels per acre.	Bushels per acre.
No Manure	50·8	36·7	5·8	33·4
Bonedust	68·3	37·5	15·5	..
Basic Phosphate, 1 cwt.	52·2	39·2	17·2	..
Thomas' Phosphate, 1 cwt.	56·9	37·4	16·7	39·6
Superphosphate, 1 cwt.	62·6	42·7	19·4	33·7
Thomas' Phosphate, 2 cwt.	72·4	40·8	20·3	38·6
Superphosphate, 2 cwt.	77·4	43·6	21·1	37·7
Superphosphate, 1 cwt., plus lime, 10 cwt. ..	69·9	40·3	19·6	42·8
Superphosphate, 2 cwt., plus lime, 10 cwt. ..	66·4	40·2	20·7	40·9
Lime, 10 cwt.	50·1	35·9	10·8	35·4

This table shows that practically all of the manures have produced substantial increases. Lime applied by itself, however, gives no beneficial result. Neither when applied with superphosphate was there any immediate gain, except at Streatham. Possibly some benefit may appear as time goes on. The results at Streatham also differ from the rest in that it is the only centre where manures of the basic type did as well as superphosphate. Thomas' phosphate was the manure of this type tested at Streatham.

The fields at Strathkellar, Cavendish, and Lismore, where all the plots were sown on stubbles and gave similar results, may be considered together.

Table Summarizing Yields of Oats Obtained at Strathkellar, Lismore, and Cavendish, and Showing Net Profit Per Acre Due to the Use of Manure.

Manurial Treatment per Acre.	Average Yield per Acre, three Centres.	Increase due to Manure per Acre.	Value of Increase at 2s. 6d. per Bushel per Acre.	Cost of Manure per Acre.	Extra Profit per Acre due to Manure.
	Bushels.	Bushels.	*s. d.*	*s. d.*	*s. d.*
No Manure	31·1	..	..	..	..
Lime, 10 cwt.	32·3	1·2	3 0	25 0	Loss .. 22 0
Superphosphate, 2 cwt.; Lime, 10 cwt.	42·4	11·3	28 3	36 0	Loss .. 7 9
Superphosphate, 1 cwt.; Lime, 10 cwt.	43·3	12·2	30 6	30 6	..
Basic Phosphate, 1 cwt. ..	36·2	5·1	12 9	5 0	Profit .. 7 9
Thomas' Phosphate, 1 cwt. ..	37·0	5·9	14 9	5 6	Profit .. 9 3
Bonedust, 1 cwt.	40·4	9·3	23 3	8 0	Profit .. 15 3
Superphosphate, 1 cwt. ..	41·6	10·5	26 3	5 6	Profit .. 20 9
Thomas' Phosphate, 2 cwt. ..	44·5	13·4	33 6	11 0	Profit .. 22 6
Superphosphate, 2 cwt. ..	47·4	16·3	40 9	11 0	Profit .. 29 9

Valuations—	£ s. d.	
Lime	2 10 0	per ton.
Bonedust	8 0 0	,, ,,
Superphosphate	5 10 0	,, ,,
Thomas' phosphate	5 10 0	,, ,,
Basic phosphate	5 0 0	,, ,,

This table is in effect a balance-sheet which sets out the increase due to each type of manure tested, and the increased crop resulting from its use. The increase has been valued at 2s. 6d. per bushel, and the cost of the manure at current market rates. By subtracting the cost from the value of the increase the profit or loss due to the use of each manure may be obtained.

The use of 2 cwt. of superphosphate has resulted in an increased profit of 29s. 9d. per acre as compared with the plot where the oats were sown without manure. Where the dressing of superphosphate was only 1 cwt. per acre the extra profit was 22s. 6d. per acre. It will be seen that where 2 cwt. was used, the extra 1 cwt. of superphosphate not only paid for itself, but returned a further profit of 9s. an acre. In addition, there is likely to be correspondingly increased feed in the pastures following the heavy dressing.

Where 1 cwt. of basic phosphate was used the profit was 7s. 9d. per acre, or 13s. an acre less than where an equivalent quantity of superphosphate was used. Thomas' phosphate proved a better manure than basic phosphate.

One cwt. bonedust gave a profit of 15s. 3d. per acre. It appeared to be especially beneficial on the heavy black volcanic soil at Strathkellar, and will be tested in combination with superphosphate in future trials.

To sum up, the outstanding lesson to be learnt from the tests is that it pays to manure the stubble oat crop in the Western District, that superphosphate is the most profitable form of manure to apply, and that dressings up to 2 cwt. per acre are very profitable. Only in one centre did the soil respond to lime or show as promising returns from manures of a basic type. It will be interesting to see what the cumulative effects of continued dressings of each type of manure will be as the years go by.

RESULTS.

Wheat Manurial Trials, Willaura.

The results of the manurial trials with Federation wheat at Willaura —the only centre so tested—are similar to those for oats. Calculating the wheat at 5s. a bushel and the manures at the rates previously indicated, and arriving at the results by the method outlined for oats, the principal results are as follow:—

TABLE SHOWING PRINCIPAL RESULTS OF MANURIAL TESTS WITH WHEAT AT WILLAURA, 1920.

Manurial Treatment (per Acre).	Net Profit per Acre due to Use of Manure.
	s. *d.*
Superphosphate, 2 cwt.	48 0
Superphosphate, 1 cwt.	46 6
Lime, 10 cwt.; plus Superphosphate, 1 cwt.	39 6
Basic Phosphate	29 6

It will be seen that acid manures of the water soluble type have again proved most profitable, and, further, that heavier dressings than are normally applied in the district give the best results. Had the higher price of 7s. 6d. a bushel been credited to the wheat the greater would have been the value of the increased crop produced by the manure, and, therefore, the more profitable the heavy dressings.

Perhaps the most interesting feature of the results from this field is the powerful influence exerted by the manures in suppressing wild oats. The field was exceptionally foul. Where no manure was appplied the wheat was so choked with wild oats that the yield averaged only 4 bushels per acre; yet the best plot—lime 10 cwt., plus superphosphate 2 cwt.—yielded 19 bushels per acre.

Wheat Variety Trials.

There was a time when fine yields of wheat were obtained in the vicinity of Casterton and in other parts of the Western District. To-day, however, the results are very moderate. Many theories have been advanced in explaining the decline. One of them is that the wheats at present grown have been all bred for northern conditions. Some new varieties were tested, but they did not prove, on the average,

superior to older types. Yandilla King was perhaps the most consistent of the varieties. At none of the centres was Federation entirely satisfactory.

Table—Wheat Variety Trials in the Western District.

Area ½ acre, seed 75 lbs. per acre, superphosphate 1 cwt. per acre. Sown second and third week in May.

Station.	Currawa.	Major.	Yandilla King.	Crossbred 78A.	Federation.	Crossbred 4106.
	Bushels per acre.	Bushels per acre.	Bushels per acre.	Bushels per acre.	Bushels per acre.	Bushels per acre.
Lismore	21·4	21·7	21·6	18·5	19·4	17·8
Strathkellar	19·7	20·4	19·4	25·2	16·1	..
Willaura	10·4	12·0	15·2	..	11·8	..
Streatham	36·6	42·5	43·6	36·5	39·6	35·8
Average	22·0	24·1	24·9	..	21·7	..

FORAGES.

Excellent growth resulted from the Wimmera rye grass in the centres where it was sown, viz., Willaura and Cavendish. Subterranean clover did well, and the lucerne established itself.

It remains to be seen how these crops will maintain themselves during the coming year.

ORIGIN OF THE ROME BEAUTY APPLE.

For the origin of this famous apple we have not to search the records of antiquity; it is barely a century old. It is not the Imperial city whose name it bears, but a small town in the United States; in fact, this apple has, according to the inscription on a monument erected in its honour, brought fame, not only to the Town of Rome, but to the State of Ohio. At the Pomological Conference, held in Melbourne a few weeks ago, a short historical sketch of the apple was read by Mr. J. R. Warren, the main points of which were as follow:—In 1816 an American citizen named Joel Gillette moved from Marietta down the Ohio River to what is now Lawrence County, and started a new home. While planting some apple trees he observed one which had a sprout below the graft, and, probably because of this defect, he gave it to his son Alanson, who planted it near the river. In a few years it bore nice fruit, and was known as Gillette's Seedling. In 1832 its name was altered to Rome Beauty, after the town near which it originated. Grafting wood was first taken off the original tree in 1827 or 1828. The variety soon showed a tendency to colour variation, and there are now several distinct types in the State of Ohio, all being good commercial apples.

HERD TESTING.

(Paper read at Conference of the Australasian Butter and Cheese Factories Managers and Secretaries Association, May, 1921.)

R. T. Archer, Senior Dairy Inspector.

Herd testing may be looked upon as the foundation of dairying, for it is the only way by which one is able to discover which cows are capable of yielding sufficient milk or butter-fat to pay for their food and the cost of their management, and of giving enough surplus "to make it worth while," or, in other words, to provide profit for the farmer. Herd-testing is quite a modern development. Very little had been done in this direction before the beginning of this century. Personally, I tested some of the farmers' cows in South Gippsland in the nineties, supplies from which came to my factory, but it was not by any means general.

In 1912 it was my privilege to assist in the inauguration of the Standard Herd Test conducted by the Department of Agriculture, and the results of nine years' work in the development of this scheme are most valuable, interesting and instructive. Some of the results obtained under this scheme would have been considered practically impossible, or, at any rate, highly improbable, in the days prior to testing. We used to read of the wonderful productive capacity of some of the champions of America, but had no idea that in this country there were cows that would produce 1,000 lbs. of butter in a year. Yet we have had that result from a Red Poll, a Jersey, and two Shorthorns. It would also have been considered very unlikely that a cow here would give milk averaging over 7 per cent. of butter-fat for the whole season; yet we have had several. However, the object of the standard herd test is not to encourage the production of phenomenal records, but to do what is considered best for the general increase in production of butter-fat in the dairy herds of Victoria. The improvement already obtained in some of the herds is an indication of what might be expected if the system became general, and there is every reason why it should become much more common than it is to-day. Although it would be a very big undertaking, it only requires organizing to make it a success. As I mentioned in a paper on the subject, I had the pleasure of reading at a former conference of this Association, I consider we have the necessary material and facilities already provided in the butter factories in every important dairying district in the State, and every butter factory should be the centre of the local Herd Testing Association.

To illustrate what may be anticipated by the general adoption of the system of herd testing, we may look at the results achieved in the Ayrshire herd of the Geelong Harbor Trust at the Sparrovale Farm. The pedigreed cows of this herd were first tested in the year 1913-14,

and have been tested each year since. The results are worth studying in detail:—

Year.	Number Entered.	Number Certificated.	Average of all Cows in the Three Classes.		
			Mature Cows.	2nd Calf Cows.	Heifers.
			lbs. butter fat.	lbs. butter fat.	lbs. butter fat.
1913–14 ..	8	1	157·12	..	..
1914–15 ..	20	8	237·22	108·45	171·31
1915–16 ..	16	6	232·49	193·28	189·13
1916–17 ..	13	5	195·70	255·00	229·33
1917–18 ..	15	8	215·01	287·82	196·81
1918–19 ..	15	15	342·23	299·47	275·58
1919–20 ..	19	19	340·71	336·89	290·95
Increase			183	228	119
At 1/- per lb.			£9 3 0	£11 8 0	£5 19 0

In another way this result illustrates exactly what is the object of the Standard Herd Test. The two bulls which are responsible for the improvement in the production in the young stock at Sparrovale were from two of the highest producers in the Gowrie Park herd, the property of Mr. W. P. Brisbane; the records of this herd are given in the annual reports published in this journal in September, 1914 and 1915.

The results of Ida of Gowrie Park are:—

Year.	Milk.	Average Test.	Butter Fat.	Milk on Last Day
	lbs.		lbs.	lbs.
1913–14	10,867¾	5·10	555	23
1914–15	11,917¼	5·08	605	26½
Scottish Queen, of Gowrie Park.				
1913–14	12,022	4·87	585¼	21

The principal features of the Victorian Standard Herd Test scheme are as follow:—

(*a*) All cattle tested must be entered in a recognised herd book, *i.e.*, only pure bred cattle may be tested under this scheme. The principal object of this is to find out which cows are worth breeding bulls from, so that a farmer may purchase a pure bred animal to place in his herd with a practical certainty that heifers got by him will be better producers than their dams. Of course, the value of a bull is not known until his daughters have been tested, but a pure bred bull from a good producing cow has a far better chance of working improvement than a mongrel of unknown breeding.

(*b*) All pure bred cows in the herd must be tested. This is where the Victorian regulations differ from most of those of other countries. The breeders who helped to frame our regulations were of the opinion that it was just as important to know which cows were not worth breeding from as those that were. Tests have proved that some of the most handsome

prize-takers in the Royal Show have not been worth breeding from. Now, when the dairy farmers in this State require a bull they may write to the breeders and find out what stock is available, then look up the dam's record in the annual herd test report. If the record is not there it means that the cow has not qualified for her certificate. If she has, her record will be there. If she has not given over 300 lbs. of butter-fat in the nine months, her bull-calf will, of course, not be worth nearly as much as one from a cow giving 400 or 500 lbs. The rule with some breeders is to value the bulls at the rate of 1s. per lb. of butter-fat that the dam gave in the year. In the case of a cow of specially good appearance from a show point of view, the bull would have a special value on that account. It is the exception and not the rule to have the two qualities combined, so when this exceptional animal puts in an appearance, he has a special value for stud purposes which would, to a great extent, be lost in an ordinary herd of cross-bred cows. In most other countries it is optional which cow a breeder has tested. In consequence, he picks out his best, has it or them tested, uses the record as an advertisement, and palms off the duffers on the strength of it. In this State it is a breeder's own fault if he is deceived in that way, for he can look up the records himself.

(*c*) The test extends over 273 days, or nine months instead of twelve. This is considered a natural milking season where cows have calves every year, and allows an animal to be dried-off and have sufficient rest before coming into milk again. This period, I believe, has been adopted in all the Australian States.

Mr. H. D. B. Cox, a New South Wales breeder, at the last Sydney Royal Show eulogized the Victorian Government system of herd testing, and pointed out that the officials were not called testers, but were supervisors. These supervisors were capable men, competent to give advice on scientific feeding.

The breeders in Tasmania have decided to adopt the rules and regulations in force in this State, and expect to have them fully operative by next season.

The Standard Herd Test is more elaborate and more costly to run than that for ordinary dairy herds, but it has laid a foundation on which to work, for half the value of general herd testing would be lost were pure bred bulls not available for those who require them.

There are very encouraging indications of the work becoming more general. A section of dairy farmers is in favour of herd testing being made compulsory. Although it is a very big undertaking it is of national importance, and the results already obtained show that the cost would be repaid many times over.

There are approximately 600,000 dairy cows in the State. On the basis of 1,000 cows per man, it would require 600 men or women to test the whole of the cows in Victoria. Assuming that it cost 4s. per cow, the total cost would be £120,000 per annum. Looked at hastily it may appear altogether too costly. However, it should be only a part of the dairy organization, and a very important part, too. There are

already employed in butter and cheese factories 1,642 hands, and the amount paid in wages is £226,000.

Assuming that on an average one person milks twelve cows daily, there will be about 50,000 hands employed in milking the cows. Allowing an average of 30s. a week, the wages will amount to about £3,900,000. Another £120,000 for 600 testers would not be such an enormous increase in expenditure.

What return might be looked for with every confidence? At least an increase of 50 lbs. of butter-fat per cow per annum from, say, 125 gallons of milk. That works out at 30,000,000 lbs. of butter-fat, and, at 1s. per lb., is worth £1,500,000. There would also be an increase of skim milk averaging 100 gallons per cow. This, at 1d. per gallon, amounts to £250,000. The increase in the value of skim milk alone would doubly pay for the cost.

There are two distinct systems in use in general herd testing. One is more costly than the other, but, at the same time, must be considered more satisfactory. The system carried out by the Colac Herd Testing Association is the one generally in vogue in Australia and New Zealand. The distinctive, also the weak feature of this is that the farmer takes his own samples. The Association has a manager who despatches the boxes of sample bottles, together with necessary charts, to the farmer, who takes the samples, records the weights, and returns them to the manager. He does all the work in connexion with the testing, works out the results and sends them in the box when the next monthly sample is to be taken. The Colac Association has found that it costs them about 2s. 9d. per cow to carry out the work, and that one man can test about 2,000 cows.

You may know that for many years past the Ayrshire cattle-breeders in Scotland have conducted testing on a very large scale, and in 1915, before the war made labour so difficult, they tested over 26,000 cows. During the war they fell back to about 14,000 cows. At the last annual meeting of the Scottish Milk Records Association it was reported that there were 37 local societies affiliated, representing 586 herds and 25,120 cows. There were employed 22 women and 31 men recorders or testers. At the present time there are 680 herds, made up of 29,250 cows, being tested. The Scottish system is similar to that generally adopted in America and Europe, and although more costly, it is more satisfactory than that in vogue at Colac. In Scotland the recorder or tester visits the farm carrying tester, sample bottles, and other requisites with him, generally in a side car attached to a motor cycle. He takes the samples, tests and works out the results, then moves on to the next farm. In some cases the farmer has to convey him to the next farm. If the tester has his own horse and buggy the farmer undertakes to stable and feed the horse. The tests are taken once a month. Theoretically, one tester may do 26 herds, but, in practice, he tests about 1,000 cows.

Thirty cows are considered a day's work, so that in case of a herd of 60 or 90 cows, the tester would stay two or three days, as the case may be, at the one farm.

The salaries vary from £180 to £300 per year, plus board and lodging.

The cost per cow varies from 4s. to 8s. per year. Sometimes the payments are on a monthly basis, *i.e.*, 7½d. per cow per month up to

50 cows, 6d. from 50 to 100 cows, and 5½d. over 100 cows, every cow in the herd to be tested.

The outfit carried by the tester consists of a 24-bottle hand Badcock, sample bottles, spring scales, and bucket heating apparatus, and necessary forms, charts, &c.

Probably the best system for this country, where the butter factory is the centre of the testing activity, would be for the recorder to take the samples and send or convey them to the factory, where there would be every facility for completing the tests. In this case one man could take the samples of a large herd on the one day, and, where small herds are close together, two might be taken on the one day. Where there is not a butter factory, but the work is done by an agricultural association or a local testing association, the former system would be found the better.

Although the system of general herd testing is very slow to develop in this country, we have the questionable satisfaction that we are not exceptional in this respect, as other dairying countries do not make the headway they would wish. But in some, very considerable advance has been made.

The system of herd testing originated in Denmark, and was started there on a co-operative basis in 1895. Now there are about 700 herd testing associations in that country. The result may be seen from the following figures:—

Year.	No. of Cows.	Average Yield per Cow.	
		Milk.	Butter.
		lbs.	lbs.
1861	756,800	2,200	68
1881	898,800	3,638	130
1903	1,089,000	5,511	216
1914	1,310,000	6,061	240
1916	1,141,000	5,886	233
1918	1,024,000	4,431	174

The falling off during the last few years of the war was due to the impossibility of obtaining sufficient food. This is a further illustration, and a very striking one, that adequate feeding is essential if the best results are to be obtained.

There are about 16,500 members of Herd Testing Associations owning 250,000 cows, or one quarter the total cows in Denmark. Each society receives a subsidy from the Government of £11 per annum, conditionally on a minimum number of ten members with 200 cows being tested. Each farmer contributes about 22s. entry fee and 5s. 6d. per cow per year.

At 1s. per lb. the value of increase since herd testing was started amounts to about £6,000,000 per annum.

In the United States of America in 1917 there were 23,372,200 cows. The number of herds tested was 12,000 in 459 associations. The individual cows tested was 212,000, equal to 0.91 per cent. of the number of cows in the country.

Wisconsin is one of the most progressive and important dairying States, and according to the most reliable authority, the average butter-fat production per cow is only 170 lbs.

In New Zealand, Mr. Singleton, the Assistant Dairy Commissioner, says that 180 lbs. of fat per cow would be a liberal estimate.

It is calculated that the average per cow in Victoria is about 160 lbs. of butter-fat. This is not far behind those above mentioned, but that is poor consolation when the cost of production is considered, and we find that half the cows are not paying their way.

Something more than has yet been done is required to arouse the farmers' interest in this important question—something to induce them to take the matter up in earnest. All those interested in the dairying industry will remember what an impetus was given to the Butter Factory System by Government bonus. Something of the kind might be applied to encourage testing of dairy cows, say, a bonus at the rate of £1 for every cow that produces 300 lbs. of butter-fat in nine months (conditionally that she re-calves within fifteen months), the testing to be done by the local Herd Testing Association, agricultural society, or butter factory, subject to inspection or supervision of a Government officer; every cow in a herd to be tested. If the number of cows claiming the bonus was too great, the standard might be raised to 400 lbs.

This would mean an enormous improvement in feeding methods, as a cow will not produce 300 lbs. of fat unless she is adequately fed. Conditions might include the use of pure bred bulls from tested cows.

A certain sum might be ear marked by the Government to cover the cost, any balance not claimed to revert to the Consolidated Revenue. If the amount voted proved not sufficient it would be an excellent thing, and a further sum might be asked for.

CATTLE IMPROVEMENT IN DENMARK.

In Denmark the trend of cattle breeding is mainly to increase the number of dairy cows and improve their quality. This is evident from the fact that the number of milch cows was almost doubled in the last half century, and that in 1914 they constituted about 54 per cent. of the total cattle population of the country. The average milk yield, which in 1861 was only 220 gallons per cow, was increased until in 1914—the latest normal year—it had reached 605 gallons per cow. During the same period the butter-fat yield was increased from about 70 lbs. to 240 lbs. per cow. . . . What is responsible for the production of the high grade milk-producing machines which the cows . . . . have now become?

Better feeding and more comfortable housing have contributed, but the main cause has been the ruthless elimination of all "bad animals," both male and female. In Denmark a "good" cow means not only a sound, healthy animal, but an animal giving a high yield of butter-fat; and similarly a "good" bull must not only be the son of a "good" cow, but must be capable of transmitting to his progeny the qualities of his line.—*Journal* of the Department of Agriculture for Ireland.

RESISTANT STOCKS.*

By F. de Castella, Government Viticulturist.

(Continued from page 289.)

Considerations Governing the Choice of a Stock.

Though there is now little difficulty in selecting a suitable stock for any given soil and scion, it is not always easy to pick the very best, and yet this is what should be aimed at when planting a vineyard. Public opinion is not an infallible guide; the popularity of stocks fluctuates, even among those which long experience has proved to be thoroughly reliable. After a series of dry years drought resistance is required; after several wet springs a stock on which the vine sets its blossom well is sought after.

I met with a curious example of fluctuating popularity at Cognac in 1908. In the late nineties No. 1202 was, in the chalky soils of that district, the most popular stock; it was superseded in public favour, however, by No. 41B, which is even more lime-tolerant, and which renders the scion more fruitful. Like du Lot, 1202 tends to stimulate growth at the expense of fruit, especially during the first few years. At the time of my visit fickle fashion was once again favouring 1202; several growers had remarked that though somewhat shy at first, this stock was, with age, bearing better, and in some cases even beating 41B. The explanation is interesting; the declining yield of 41B was not due to any defect of this stock, but was the indirect result of one of its chief merits, viz., heavy fruit production. It is easy to understand that the heavier-bearing vine, by taking more out of the soil, hastens the time when restitution in the shape of manuring must be made. Heavy manuring not being the rule in Cognac a time had come when 1202, which had taken less out of the land, had the advantage over its somewhat fatigued rival. "You can't have your cake and eat it," as was realized by the pessimistic Victorian farmer, who, when congratulated by a friend on the splendid wheat crop he had just harvested, replied, "That's all right old man, but look at all it has taken out of the land." With adequate manuring 41B would have certainly maintained its heavy production. "Le mieux est l'ennemi du bien," says the French equivalent of "Leave well alone," and in the quest for the best possible stock there is danger of following "Will o' the Wisps." So has it ever been since the dawn of reconstitution, the high road of which is strewn with corpses in the shape of the shattered reputations of discarded stocks for which bright futures were predicted by those qualified to speak with authority. Few, indeed, are those which have made good.

A certain amount of courage or even of recklessness is needed for the establishment, on a large scale, of "mother vine" plantations of new stocks, no matter how promising they may seem. Can those charged with the responsibility of propagating these vines be blamed if they adhere to the safer course of multiplying stocks of absolutely proved value, rather than gamble on the chances of striking something better, not matter how promising the trail may seem? Careful experimentation is the only reliable guide, and for this there is a vast field. In Victoria propagation has so fully occupied the activities of the Viticultural branch that experimental work has had to take second place. Nor has the need for such been very urgent with us; in the

* Paper read at the Adelaide Wine Congress, May, 1921.

easy and not very "phylloxerating" soils of north-east Victoria the success of the "five fundamentals" has been so striking that we have not been driven by dire necessity to seek for anything much better. Other parts of Australia may be less fortunate, and problems will doubtless occasionally arise in connexion with such questions as—

(*a*) Phylloxera resistance.

(*b*) Adaptation to soil; in connexion with which must be considered drought resistance, tolerance of lime, of salt, of excessive soil moisture, &c.

(*c*) Affinity between stock and scion.

Phylloxera Resistance.

Resistance is the keystone of reconstitution; the *raison d'etre* of the American vine. A resistant stock which does not resist is a contradiction in terms which savours of the ridiculous. And yet resistance is only relative; no vine on which Vinifera varieties can be satisfactorily grafted is absolutely resistant. Phylloxera can live on the roots of even the best stocks, but without injuring them, or multiplying to any extent.

Scale of Resistance to Phylloxera.

	Viala & Ravaz.	Foex.
Absolute immunity	20	—
Vitis rotundifolia	19	—
Vitis riparia (Gloire, &c.)	18	18
V. rupestris (Martin, Ganzin, &c.)	18	18
Riparia x Rupestris, 3309, 3306, and 101-14	—	18
V. cordifolia (various forms)	18	—
V. arizonica	18	—
V. monticola	17	—
V. berlandieri (several)	17	17
Berlandieri x Riparia 34E	—	17
Chasselas x Berlandieri 41B	—	17?
V. æstivalis (wild form)	16	—
Rupestris du Lot	16	18
Cabernet x Berlandieri No. 333	—	16?
A.R.G. 1 and 2	—	16?
V. cinerea	15	—
V. candicans	15	—
V. Lincecumii	14	—
Solonis	14	14
Vialla	14	14
Noah	14	—
Taylor	13	13
Jacquez	12	12
York's Madeira and Black July	11	—
Elvira	10	—
Othello	6	—
Alvey	7	—
Isabella & Wild Labruscas	5	—
V. Californica	4	—
Concord	3	—
V. Cognetiæ (Asiatic)	3	—
V. Amurensis (Asiatic)	2	—
Colombeau, Uni blanc, &c.	1	—
Most other Viniferas	0	—

According to Vialá and Ravaz, the numbers 16 to 20 correspond to a sufficient resistance for all soils; the numbers 14 and 15 express a resistance sufficient for sandy and damp soils, where phylloxera does little harm; *No.* 13 *and under should be totally discarded from vineyards.*

The above scale, though useful to explain the broad lines of the question, must not be taken too literally; resistance depends on many factors, and cannot be expressed arithmetically. Nor are authorities in agreement; Viala and Ravaz are not in accord with Foex, concerning Rupestris du Lot for example. The latter estimates its resistance at 18, the former only at 16; and yet du Lot is one of the best known and most trusted stocks! The queries placed after some of the scale notes by Foex are significant. Scale numbers are seldom referred to now; resistance is more usually defined by stating that a given stock is equal or superior to that of Jacquez, Solonis, or some other well-known vine; such an estimate being nearly always qualified by the word "perhaps."

Specific resistance is hard to gauge; highly-resistant vines bear few and shallow tuberosities, which are, of course, more numerous on the roots of those which resist less. Artificial phylloxera infection and subsequent root examination is difficult and often misleading. It is curious that some poor resisters are remarkably free from phylloxera on the terminal roots, though liable to dangerous tuberosities on the larger ones; the seeming dislike of the insect for such vines has credited them with a degree of resistance they do not merit.

Resistance varies enormously with the soil—in sand all vines resist—even Viniferas. On dry, shallow, hillside soils, on the other hand, phylloxera is particularly virulent, especially if they contain much lime, which element increases in a marked degree the vulnerability of the vine. Between these two extremes every degree of difference is possible. According as the soil tends towards the former or towards the latter, so will the liability to the insect diminish or increase; the need for high specific resistance in the stock varying in harmony. French authorities distinguish between soils which are "phylloxerating," and those which are not; a stock which is amply resistant in the latter may be insufficiently so in the former. Rutherglen soils are not highly phylloxerating, and it is possible that some stocks, which thrive there, may be found wanting in other localities, especially on limy soils.

A familiar French example may be mentioned. In Beaujolais (near Burgundy), where the geological formations (granitic and schistose) are not unlike those of Rutherglen, the almost obsolete Vialla has long been the favorite stock; it is still in use there. This Labrusca-Riparia hybrid, which is only credited with a resistance of 14 points, has long since been discarded in Southern France, where it soon succumbed to phylloxera.

In irrigated vineyards very high resistance is less necessary, and any stock which succeeds at Rutherglen should amply suffice in this respect. Irrigation undoubtedly reduces the activity of phylloxera, though not sufficiently to permit the survival of the European vine on its own roots. Nothing short of submersion—flooding once each year for 40 days without a break—can enable the ungrafted Vinifera to defy phylloxera, except in almost pure sand.

Nor must we lose sight of the influence of climate, which plays a most important part. If this be warm, with long growing period and short

winter rest, the activity of the insect is necessarily greater, and a couple of additional generations per year are sometimes possible as compared with cooler districts; hence it is that complaints of insufficient resistance come chiefly from warm regions; a fact which it would be unwise to overlook in Australia.

Affinity also plays an important part; if this be considerable and the scion a strong grower the union will result in a big vine with root system developing in proportion. Big vines fear phylloxera less than smaller ones, as witness large trellises, which still survive in France in localities where the smaller vines in the vineyards were soon destroyed. Hence it is that grafting with a European scion lessens the resistance of a stock. Thus Jacquez, which was much used as a stock in the nineties, often succumbed to phylloxera in the same soil where grown as a direct producer it showed much higher resistance.

Resistance is not the only consideration, especialy in easy soils. The discarded Riparia is one of the most resistant of vines; on the other hand Rupestris du Lot, one of the least resistant of the pure Rupestris, has everywhere superseded its more resistant brothers.

It is in dry, shallow, limy soils, that high resistance becomes a *sine qua non*; from Sicily, Northern Africa, and Spain come recent warnings, which cannot be disregarded. Authentic cases are on record where the decline of vines grafted on such stocks as A.R.G.1 and 1202 has been proved to have been caused by phylloxera. For such distinctly phylloxerating soils most of the Vinifera-American hybrids, possibly with the exception of 41B, must be looked upon with suspicion, and the choice restricted to vines of higher resistance.

Adaptation.

The European vine is not exacting as regards soil; it will grow almost anywhere. The American vine is not quite so accommodating; nor is this surprising, seeing that it comprises several distinct species, each of which grows wild in a different region, with soil conditions more or less special to it. Though hybridization has somewhat mitigated such differences it has not eliminated them altogether, and the suiting of the stock to the soil still demands careful attention. We are fortunate, however, in now having stocks suited to every soil in which vines were grown in pre-phylloxera days.

Climate must also be considered; a stock well suited for a cold district may prove unsatisfactory in a warm, dry one. Thus *V. riparia*, a native of the colder states of the Union, though still planted in Northern and Central France, has been discarded in Algeria. It is out of place in our warm Australian climate, for which more southern species, such as Rupestris and Berlandieri, are better suited. Riparia will only survive here in its hybrids, among which we certainly have stocks of very high merit, such as 3309, 3306, and 420A.

Soils may be divided, as regards adaptation, into easy and difficult ones.

Easy soils are those which are free and deep, only moderately provided with lime and overlying a penetrable sub-soil. Most of the soils in the Rutherglen district, where Victorian reconstitution has mainly been carried out, are easy soils; so much so that adaptation problems have given but little trouble. The stocks referred to above as the five fundamentals have given a remarkable measure of success.

Affinity problems have certainly arisen, as will be described presently, but as regards adaptation differences in the behaviour of the various stocks in general use are much less striking than might reasonably have been expected.

In difficult soils problems chiefly arise in connexion with—

Lime in excess, which causes Chlorosis.
Stiff clay soils—silty or otherwise.
Excessive moisture and faulty drainage.
Salt.

Lime and Chlorosis.—In soils containing much lime, most American vines are subject to a disease called Chlorosis; the leaves turn yellow and vegetation languishes. In extreme cases the vine may even die. In this respect American vines differ radically from the old Vinifera sorts, which are lime-tolerant to an extraordinary degree. In Cognac and Champagne, in pre-phylloxera days, thriving vineyards were frequent in soils containing up to 80 per cent. of lime carbonate (44 per cent. expressed as lime). It is doubtful if such soils exist in Australia. The highest lime content of any Victorian vineyard soils as yet analyzed was 10 per cent. (18 per cent. as carbonate). If they exist we still have stocks, but they require closer attention.

Liability to chlorosis depends less on total lime content than on its physical condition. The finer the state of division the more harmful does the lime carbonate become, hence it is that chalky soils are particularly difficult. Ingenious self-registering calcimeters have been invented in France which permit of the liability to chlorosis being fairly accurately gauged. These instruments automatically record the rate of attack by an acid solution. This, of course, depends chiefly on the fineness of the particles.

Chlorosis is aggravated by grafting. A stock which remains green on its own roots may suffer when grafted, the scion leaves being quite yellow. Moist soil conditions increase the liability to chlorosis. In limey districts it is more in evidence in a wet than in a dry Spring. Much information concerning lime and chlorosis will be found in *American Vines*, by Viala and Ravaz, a translation of which is obtainable from the Victorian Department of Agriculture.

It will be seen that it is difficult to assign a definite lime limit for a given stock. *V. riparia* suffers in soil containing 15 per cent. (8 per cent. as lime). Rupestris du Lot can tolerate up to 25 per cent. (14 per cent. lime). Nos. 3306 and 3309, though fairly tolerant, are less so than du Lot, whilst A.R.G.1 is more tolerant. No. 1202 can stand up to 30 per cent. carbonate in chalky form, whilst 41B, 333, and some of the selected pure Berlandieris, will tolerate even more. Though lime trouble is not likely to force the use of the pure Berlandieris on us in Australia, the remarkable qualities of this stock in other directions may lead to its use if propagation difficulties can be satisfactorily overcome.

Stiff clay soils are also difficult to suit, especially those which dry out in summer without cracking—soils which are almost impossible to cultivate unless taken at the right moment, a class which practical vine-growers know only too well. For such the Cordifolia hybrids 106-8, 125-1, 107-11, and 62-66, are specially suited. The first of these is doing well in northern Victoria. The remaining three have not yet been thoroughly tested with us. These stocks inherit from the Cordifolia parent considerable drought resistance. They are, however, very

intolerant of lime, and in soils containing more than 5 per cent., expressed as lime, they must not be planted parted.

The Riparia x Rupestris hybrids 3306 and 3309 do well in stiff soils, as do also A.R.G.1 and 1202. The greater phylloxera resistance of the first two should be borne in mind in soils where there is a possibility of injury being caused by the insect.

Faulty Drainage.—Some American stocks have a marked dislike for "wet feet," notably Berlandieri and its hybrids. In this respect 41B seems to be more susceptible than 420A, which should be preferred in irrigated vineyards. A case of dying-off of No. 101-14, after a summer irrigation, has already been mentioned. Though 3306 is said to resist swampy conditions, and to be refractory to Pourridie (root rot), it has been disappointing in irrigated vineyards at Mildura and Shepparton, where it is distinctly inferior to A.R.G.1. This last is—so far as present experience goes—the best all-round stock for irrigated vineyards.

Irrigation does not necessarily imply faulty drainage. Even in land where this is perfect a heavy summer watering may cause certain vines to die off in the same way as 101-14. Similar cases are not uncommon with apricots and some other trees. Nothing of the kind has, however, been recorded with A.R.G.1 or Metallica Cape—the two stocks which have been most extensively re-planted under irrigation at Mildura.

Rupestris du Lot has the reputation of being liable to root rot; nevertheless it seems to do well under irrigation at Shepparton. The tendency of this stock to promote growth, sometimes at the expense of fruit, render it, perhaps less desirable for irrigated vineyards than A.R.G.1.

Salt in excess is injurious to all vines—to American as well as European. Some stocks can stand it better than others, notably the discarded Solonis. It is for this reason that Solonis x Riparia, No. 1616, was recommended for such soils. The evidence concerning its behaviour is, however, contradictory. A very salt resistant stock is No. 3103 (Gamay Couderc). Though generally inferior to 1202 in other respects, its salt tolerance may make it of value in certain cases.

Drought resistance logically comes under the heading of Adaptation. The evidence concerning it is unfortunately rather contradictory, and it is not possible to assign a definite resistance factor to each stock, no doubt because drought resistance depends on so many conditions, some of which may be in conflict.

The suitability of the stock to the soil is necessarily of great importance. This is very evident in the contradictory behaviour of Rupestris du Lot as regards drought. This stock stands well on deep soils, where its roots can plunge sufficiently, but suffers badly in shallow soils.

The influence of the scion is also very considerable; nor should this be surprising. The roots no doubt obtain the moisture from the soil, but it is the leaves which evaporate it. A wild American may, like *V. cordifolia*, be extremely drought resistant ungrafted, but it may behave differently when artificially fitted with an upper portion not its own. Scions which result in very vigorous growth sometimes expose the vine to suffer from drought. A moderate-sized wiry vine will naturally suffer less than a more vigorous grower, with much top

hamper in the way of leaves, which will prove more exacting and demand much more water from the roots.

The influence of a strong-growing vine is in this respect somewhat similar to that of manuring. Manured vines usually suffer more in a drought because, through their more abundant foliage, they evaporate more moisture.

In the drought of 1914-15 careful observation failed to reveal any very striking superiority of one stock over another at Rutherglen. The evidence was often contradictory. In well worked vineyards the resistance of the five fundamental stocks was most gratifying.

Affinity.

Though perhaps the most vital phase of the whole question, the information available concerning it is not as complete as could be desired. We know that certain scions do well grafted on certain stocks, whilst they are unsatisfactory on others, but no comprehensive list of desirable and undesirable combinations has yet been compiled. Such a list would be of great value, as it would inform as to what unions can be undertaken with confidence, and what ones are to be carefully avoided. The graft may be compared to the alliance between husband and wife, and faulty affinity considered the equivalent of incompatibility of temper. We thus have happy and unhappy marriages in vines as well as in humans. With vines, though, divorce is more difficult, since re-grafting entails the loss of a crop and a half.

Affinity may be defined as the harmony existing between stock and scion after grafting. As a rule the closer the botanical relationship between these, the greater the affinity. There is little affinity between *V. rotundifolia*—(Muscadinia section, of which Scuppernong is the best known example)—and *V. vinifera*. The graft takes easily enough, but the union is ephemeral and soon fails. Affinity is at its maximum with Vinifera grafted on Vinifera. Between these extremes many degrees are possible.

V. vinifera has for *V. riparia* only moderate affinity—the scion soon outgrows the stock, and the union eventually weakens. It is better with Rupestris; better still with Riparia x Rupestris and Cordifolia hybrids, and particularly so with Berlandieri and its hybrids. It is excellent with the Vinifera x American hybrids, though there are a few queer exceptions.

In horticulture we find similar cases. Take the pear, for example, which may be grafted on seedling pear, quince, or hawthorn,* affinity being, of course, greatest in the first case. On quince the graft takes easily; the tree makes good growth at first, coming into bearing early and yielding fruit of excellent quality, large, and juicy. On seedling stock growth is slower at first, and the tree takes longer to come into bearing. On quince stock the tree is more exacting as regards soil richness; the scion out-grows the stock, and is prematurely old just when that grafted on seedling pear is reaching its prime. The case is very similar to Vinifera on Riparia stock. Defective affinity, though not favorable to longevity, rather stimulates fruit production during the first few years. It is a law of nature that vegetative activity and fruit production should be antagonistic.

* In France, the pear is sometimes grafted on hawthorn, a stock which will grow on soils unsuitable for quince or seedling pear (poor, sandy and chalky soils). Only a few varieties do well on hawthorn, for which the pear has less affinity than for seedling pear or even quince.

Adaptation has given but little trouble in Victoria, but we have had some experience of faulty affinity. The rare failures in connexion with our re-constitution are, in fact, due to this cause. Adaptation and affinity are correlated to a considerable extent. Faulty affinity may cause the stock to decline in a soil where it would do well if grafted with a different scion. On the other hand, a stock not too well adapted to the soil will less satisfactorily nourish a scion for which it has not complete affinity.

Though cases have occasionally been chronicled of striking success or more or less complete failure, no complete list of happy and unhappy marriages has yet been compiled. This is to be regretted, as a list of the kind would enable many costly mistakes to be avoided.

Scions may be classed as "good" and "bad," the former doing well on most stocks, whilst the latter are hard to suit. Likewise with stocks there are "easy" ones, which will take almost any scion; and "difficult" ones, which only suit a few. There are, however, queer discrepancies, which make it desirable to have previous information for each particular case. Scions have their individual antipathies, which are often quite unexpected, and cannot be explained. Zante Currant for example, which does very well on A.R.G.1, is a failure on 1202; yet both these stocks are Vinifera x American, a group for which Vinifera vines are held to have the greatest affinity. Gordo, on the other hand, does far better on 1202 than on A.R.G.1.

Strange cases of faulty affinity are occasionally met with even with Vinifera grafted on Vinifera, Malbeck on Black Prince, and Syra on Pinot Blanc, for example. It should not be surprising, therefore, that lack of affinity should sometimes show itself between vines much less closely related.

An extensive experimental plot for the testing of affinity questions has recently been established at the Rutherglen Viticultural Station, and is being extended each year. Though none of the vines are more than four-years old, some interesting facts have already been noticed.

A valuable contribution to viticultural literature concerning affinity appeared in last month's *Brewers' Journal*, in which Messrs. Burney and Wilkinson record their long experience of various stocks and scions in the Rutherglen district.

The Gordo Blanco and Muscat of Alexandria are notoriously bad scions. All Muscats are more or less difficult, though our brown Muscat (probably the Red Madeira Muscat) and White Frontignan are better than most others. They are quite satisfactory on 1202, which is the stock on which they are generally grafted at Rutherglen. Gordo seems, however, to be one of the worst of the Muscat group. On most stocks faulty affinity is evidenced at an early age by stunted growth, and even by odd vines dying off. It must be remembered that Gordo is not a very long-lived vine even on its own roots. At Malaga (Spain), Salas y Amat reports that, though not perfect on 1202, it is much more satisfactory on it than on A.R.G.1, on which it soon declines and even dies. He states that it does very well on No. 160-19 (Rupestris x Calcicola). Near Montpellier I saw Muscat of Alexandria doing well on No. 62-66 (Gamay Coudere x Cordifolia). At the Cape, Gordo, which is there called Hanepoot, is usually grafted on Jacquez, on which it is said to thrive. This stock may be of use for Gordo on sandy soil, where its poor phylloxera resistance (12) would not be of any consequence. In

California Professor Bioletti finds 41B a very suitable stock for Gordo, though the grafts are as yet too young to give much idea as to durability. He reports that at Davis 41B has given the best results with more scion varieties than any other stock. These include Muscat, Black Corinth (Zante), Sultana, Tokay, and Cornichon. Berlandieri and its hybrids have in France the reputation of being good stocks for difficult scions. Strange to say 420A, though a first-class stock for many scions, has poor affinity for a few kinds, notably Albillo, Rachette, and Alicante, Bouschet. At the Rutherglen Viticultural Station, Gordo seems to do well on 420A.

The Sultana is an excellent scion, which thrives on practically every stock on which it has yet been tried. At Mildura it does very well on A.R.G.1.

The Zante Currant is not nearly so easy to suit. At the Viticultural Station it is good on A.R.G.1, fair on 3309 and 3306, rather unsatisfactory on 101-14, and bad on 1202.

Ohanez is also a difficult scion. It does well at the Viticultural Station on A.R.G.1 and 84-3 it is fair on 3306 and 3309, poor on 101-14, and unsatisfactory on 1202.

Table grapes vary a good deal. Purple Cornichon and Valensi seem to be good scions, as also do Rosaki (Waltham Cross) and Doradillo. The last named seems to have somehow acquired an undeserved reputation for faulty affinity. At the Viticultural Station it is, however, doing very well on many different stocks.

As regards wine varieties, an enormous number of combinations is, of course, possible. The following sorts are generally easy to suit with a stock—Syra (Shiraz), Uni Blanc (White Hermitage), Carignane, Clairette, Calmette. Amongst scions which are less easy may be mentioned Mataro, Cinsaut (often erroneously called Black Hamburg), Petit Bouschet, &c.

Amongst striking cases of faulty affinity at Rutherglen are Chasselas on 101-14, Rutherglen Tokay (probably the Hungarian Hars Levelu) on 1202, Rashette and Albillo on 420A, and Gordo Blanco on 3309 and 3306, and in fact on most resistant stocks.

Influence of Stock on Yield, Quality and Date of Ripening.

The influence of the stock in these directions is undeniable.

Some stocks promote fruitfulness more than others, Riparia, for example; but it soon runs itself out. Berlandieri and its hybrids have most of the good qualities of Riparia in this respect, without its defects. Rupestris tends to promote growth, sometimes at the expense of fruit. The case of Malbeck on Du Lot has already been mentioned. Scions which are heavy bearers should be grafted on stocks of the latter type, and medium bearers on the former. A very heavy bearer, grafted on a stock which forces fruit may, unless judiciously pruned, suffer from over-production.

The influence of the stock on quality is largely the result of the foregoing. Heavy yield necessarily entails reduction in must gravity. The influence of the stock is similar to that of manuring; in olden days the use of manure was strictly regulated, and even prohibited, in some high-class vineyards, lest yield should be forced at the expense of quality. In other respects the stock does not affect the quality of the

wine. It can cause no alteration in the flavour of the grapes. So it is in horticulture; pears grafted on quince derive no foreign flavour from the stock.

The date of ripening is influenced by the stock. Vines grafted on Riparia ripen their fruit earlier than on Rupestris. Berlandieri and its hybrids appreciably hasten maturity. In Algeria, where Early Chasselas is much shipped to France, this variety is usually grafted on 41B, on which the fruit ripens a fortnight earlier than on some other stocks. In a cool climate, where insufficient maturity often reduces the quality of the wine, this variation in the time of ripening may have considerable influence on the quality of the wine. In our warmer climate it is less noticeable.

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From the above it will be seen that reconstitution is a many-sided question, every phase of which must be carefully considered, in order to get the best results. In north-eastern Victoria we have achieved most gratifying success, but we must strive after even better things, if possible, in the directions of increased yield, quality, and longevity, of the grafted vine.

DOWNY MILDEW IN SOUTH AUSTRALIA.

The Consulting Vegetable Pathologist and Botanist recently visited Renmark to examine the outbreak of downy mildew (Plasmopara viticolo) and he found certain evidence of downy mildew on currant and Gordo vines. Sultanas showed suspicious areas, but he has not been able to grow out the fungus from these specimens.

At Berri, downy mildew was found on Doradillo and Sultanas, both nursery stock and trellised vines; also in the Government Orchard in Gordo and Doradillo vines.

"The infection in all cases seen has been slight," Professor Osborn reports; "very distinct and restricted spots occurring on the leaves, which, after experience, one can recognise even after the diseased area is dead and the fungus no longer sporing.

"Unfortunately the severity of infection one season is no guide as to the probable severity in the next; everything depends on the weather, and all growers should be aware of the danger. The Renmark growers were well warned after Mr. L. Buring's visit. Some had also been to Mildura, to see an epidemic outbreak for themselves."

"No vine-growing area in the State can be considered safe for next season," the Professor continues, "as the fungus has in Victoria and New South Wales given ample demonstration of its power to spread over long distances, and to appear in epidemic form in the first season if the weather conditions are suitable. That we in South Australia escaped so lightly this year is probably due to the arrival of the fungus late in the season."

PEACH-GROWING IN VICTORIA.

(Continued from page 297.)

By A. G. McCalman, Orchard Supervisor.

X.—IRRIGATION.

In the warm northern areas irrigation is essential to obtain the best results with peach-growing. In the districts about Shepparton, Ardmona, and through to Tongala, &c., and Stanhope, the rainfall averages about 18 inches, most of which falls in the winter months, the period from September to April being usually very dry. It is during this period that watering is necessary to supplement the scanty rainfall. The number of waterings will vary with the season, the nature of the soil, and the age of the trees. For young trees not in bearing, two to three waterings are generally ample. In a dry spring the first watering is given towards the end of October, the second from six to eight weeks later, and the third about six weeks later again. This applies to suitable soils in the Goulburn Valley, but soils which have a gravelly subsoil instead of a friable clay require more frequent applications. The irrigator must use his own judgment as to when the trees are in need of moisture, and if the leaves show signs of limpness water should be applied without delay.

For irrigating young trees, a fairly deep plough furrow should be run out on each side along the row of trees, about 2 ft. 6 in. from the trees, and the ends connected with the head-ditch on the head-land. The water is supplied to the furrows from the head-ditch by means of ½-in. or ¾-in. iron pipes cut into 2-ft. lengths placed through the bank of the head-ditch. (Fig. 31.) For young trees, the furrows should not be too long, but should vary in length according to the fall of the land up to 10 chains, below which another cross-ditch should be placed to irrigate the lower portion of the block. This cross-ditch need not be permanent but can be ploughed out after irrigating, so as not to interfere with the cultivation. With older trees as many as 50 trees in a row are irrigated, sometimes without a cross-ditch, or a length of 330 yards. The water is allowed to run down the furrows till it reaches the end. When the lower end is well soaked, that is, when the soil between the two furrows is all moist, earth is thrown into the furrows just above the well-soaked part. The soil above the checks then becomes soaked, and fresh checks are put in, and so on until the head ditch is reached, and the work is completed. Great care must be taken to regulate the water flowing through the pipes in the supply ditch, so that water will not flow over the checks placed in the furrows, and the pipes must occasionally be cleared of leaves and rubbish.

In order that all the pipes may receive an equal supply of water it will be necessary to place checks here and there in the head-ditch. The checks are easily made by throwing in some earth and placing some sacking over it, over which the water flows.

Concrete pipes or short hollow logs are sometimes used for the same purpose, a door which can be raised or lowered being placed over the end to regulate the flow, but the former method is quite satisfactory, and the height is easily raised or lowered as is found necessary.

If the ground has been properly graded, or is naturally even, the irrigator will soon become expert in distributing the water, so that every

tree will receive a sufficient supply. When the water has seeped through between the furrows so that the soil is all moist, the trees have had sufficient, and no more should be given.

Where the soil absorbs a large amount of water two or more pipes should be placed in the head-ditch for each row of trees, and the head-ditches should not be too far apart. Young trees especially are liable to be killed by the use of too much water, particularly if it be supplied in a small stream, and therefore allowed to run on to the land for an excessive time.

The old method of breaking the bank of the main ditch at each furrow instead of using the pipes is a very unsatisfactory method of working. Some of the furrows invariably get more water than others,

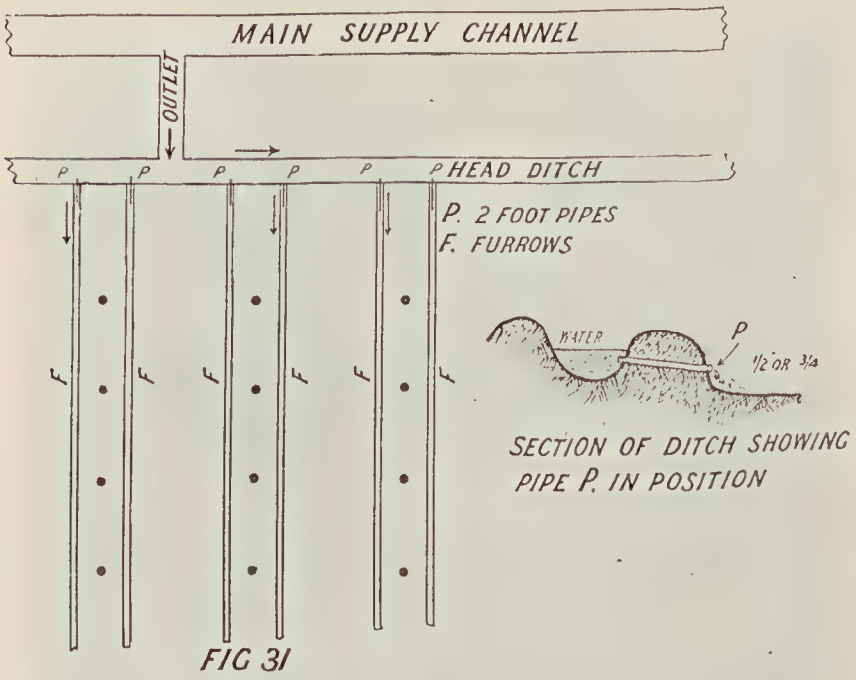

Fig. 31.—Plan of rows being irrigated from head ditch.

and unless constantly watched, and the flow checked, flooding will result, occasioning loss of water, and subsequent trouble when cultivating.

In the second year the furrows should be formed a little further out from the rows of trees, and in the third year four or five furrows should be made between each row, so that all the land between the trees will be soaked.

When trees are in bearing they should be irrigated about ten or twelve days before fruit-picking starts, in order to swell the fruit, and the time for this will vary with the variety's time of ripening. Fig. 32 is a photograph of six-year-old trees being irrigated at Ardmona, showing the head-ditch supplying water to the furrows, there being five furrows to each row of trees.

From where the photograph was taken the ground had been irrigated and thoroughly cultivated, and fruit-picking was in progress.

After irrigating, as soon as the ground is sufficiently firm, the whole of the irrigated portion must be thoroughly cultivated to a depth of about 4 inches, and any soil near the butts of the trees missed by the machine should be worked up by hand.

The more thoroughly this is done the longer the moisture will be retained by the soil and be of benefit to the trees. Cultivation breaks up the capillary tubes, which form in the soil and allow the escape of moisture. It also prevents the formation of a hard crust, and then the loose soil acts as a mulch, keeping the ground below cool and moist. Heavy soils require a great deal more working up than free soils, and this is one reason for avoiding them.

Fig. 33 is a photograph of a double-furrow plough having a special attachment by means of which the second mould-board is shifted out so

Fig. 32.—Peach Orchard under Irrigation—five furrows to the row—head-ditch in the foreground.

as to leave a space of 3 feet between it and the other. With this implement two irrigation furrows are made in one operation, which is a considerable saving of time in large orchards.

In the fruit-growing districts in the vicinity of Melbourne, where growers have to conserve water by means of dams, and the supply is therefore very limited, a different method of distributing the water is used. A large tank or dam is excavated in a low part of the land, and filled with water by drainage from the higher ground in the vicinity.

Another tank is excavated on the highest part of the orchard, and the water pumped into it from the other. This water is distributed along the rows by a single furrow run down alongside the row of trees, and on the upper side of each tree a small ditch, about 5 feet long, at right angles to the furrow, is made with a shovel. These ditches are

filled with water from the furrow, and after it has soaked away, a fresh supply is run down the furrow and the ditches refilled. This method is only advisable when the water available is insufficient to irrigate in the ordinary way. A full description by Mr. J. Farrell of the methods employed in excavating and forming the dams will be found in the August, 1918, number of this journal.

XI.—DRAINAGE.

The peach, like other stone fruits, is easily injured by an excess of water, and where the ground is not naturally well drained, subsoil drainage is essential. In addition, provision should be always made for the removal of surplus surface water resulting from heavy rains. In

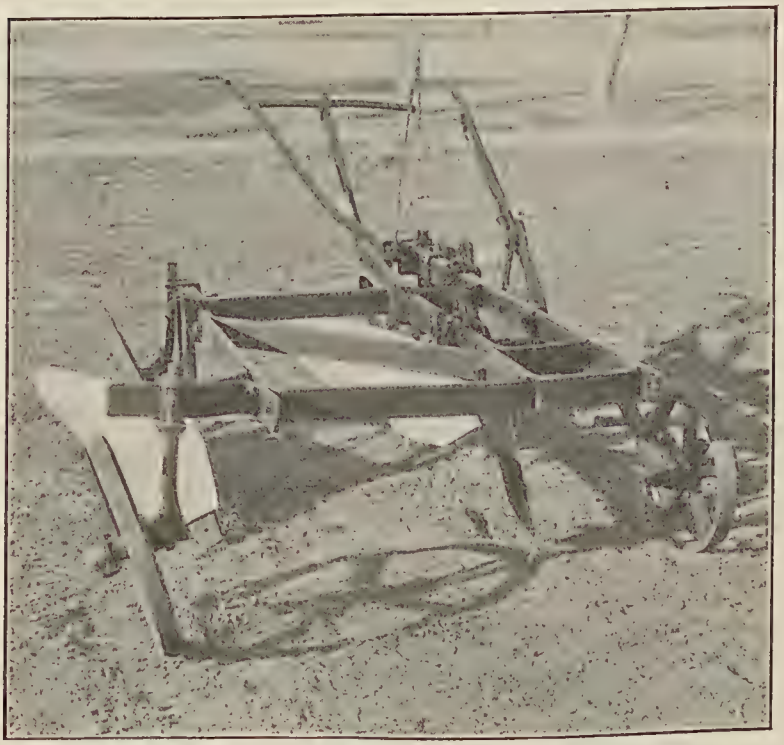

Fig. 33.—Double-furrow Plough fitted with extension device for making irrigation furrows.

order to provide for this, the ploughing in autumn should be towards the trees, the finishing furrow being along the middle of each row. These furrows act as drains, and should be connected with a ditch formed along the headland at the lower end of the block. If the ground be hilly, the ploughing should be done in a direction that will give a gentle fall, otherwise the furrows will scour.

Underground drainage is not necessary on the best peach-growing land, but if the subsoil becomes saturated in winter, the trees after a few years are bound to suffer, and subsoil drainage must be provided. Where springs occur in the orchard, subsoil drains must be put in to drain these, though it may not be necessary over the whole area.

Subsoil drainage is generally carried out after the orchard has been planted, and the drains placed along the centre of every other row, about 2 ft. 6 in. to 3 feet below the surface. If the subsoil be very retentive a drain may be required between each row of trees; but such soils are not suitable for peach-growing.

The work of tile draining should be done in the winter, when the subsoil is moist and easily removed. The surface soil should be thrown out with the plough, and the work completed by means of special drainage spades and scoops with long narrow blades and long handles. The scoop is used to form a curved bed at the bottom of the drain, in which the tiles are bedded. The bottom of the drain must have an even fall to the main drain, so that in undulating land the drain will be at a greater or lesser distance from the surface, according to the contour. The tiles are in foot lengths, and vary in diameter from 2 to 3 inches, according to the length of the drains. They should be laid along the bottom of the drain, and placed as closely as possible to each other, so as to prevent sand finding its way in between the joints. For this reason tiles with broken ends or ends which are not square should be rejected. The drains should have an outfall into an open ditch, the bottom of which should be 3 or 4 inches below the drains opening into it, in order to obviate the danger of its being choked by rubbish. Alternatively they should open into a tile drain of 4 inches or so in diameter. The drains should run down the slope of the land.

The subject of underground drainage has been more fully dealt with in an article by Mr. Farrell in the April, 1918, number of this journal.

The benefits resulting from underground drainage are numerous. It removes surplus water, which is injurious to the roots; assists in aerating the soil, as the water which is drained away is replaced by air, and this increases bacterial activity; the depth of the soil in which the roots are able to feed is increased, and the winter operations, such as ploughing, pruning, spraying, &c., are greatly facilitated owing to the rapidity with which the surface soil becomes firm after rain.

(*To be continued.*)

AN ORCHARD SPRAYING TABLE.

(*P. J. Carmody, Chief Orchard Supervisor.*)

Disease.	Spray Material.	Strength.	Time to Apply.
Apple and Pear Scab	Lime Sulphur..	1 in 12	1st spraying, when buds show pink
" "	" " ..	1 in 25	2nd spraying, when centre buds are open
" "	Bordeaux Mixture or Copper Soda ..	6–4–50 / 6–8–50	When buds show pink
Leaf Curl ..	Lime Sulphur..	1 in 12	Just before buds open
" ..	Bordeaux Mixture	6–4–50	" "
" ..	Copper Soda ..	6–8–50	" "
Shot Hole ..	Same as Apple and Pear Scab		

AN ORCHARD SPRAYING TABLE—*continued.*

Disease.	Spray Material.	Strength.	Time to Apply.
Brown Rot ..	Lime Sulphur..	1 in 10	1st, just before buds open
„ ..	Self-boiled Lime Sulphur	8–8–50	2nd, about a month after petals fall
„ ..	„ „	„	3rd, two to three weeks later still
Armellaria mellea	Bordeaux Mixture	6–4–40	Remove soil from round trunk, and expose large roots
	or		
	Copper Soda ..	6–8–40	Spray late autumn
Pythiacystis Citrophthora (on citrus trees)	Bordeaux Mixture	6–4–40	April and May
	or		
	Copper Soda ..	6–8–40	
Codlin Moth and Root Borer	Arsenate of lead	3 lbs. to 50 gals.	1st, a week after petals fall, and at intervals of from 21 to 30 days until within 21 days of harvesting in the case of early fruit, and until about the end of February in the case of late fruit. In northern districts and dry summers at shorter intervals
Pear and Cherry Slug	„ „	2 lbs. to 50 gals.	At first appearance of eggs on leaf if fruit is not approaching ripening stage. Otherwise after crop is picked, or use Hellebore
Peach Aphis, Woolly Aphis, Mussel Scale	Miscible Oil ..	1 in 25	In early Spring or late Autumn
„ „	Nicotox, or any other effective tobacco extract	1 in 50	In Winter or Summer
Red Scale or Olive Scale (on citrus trees)	Miscible Oil ..	1 in 40	In February or March, or when trees are vigorous and insects hatched
San Jose Scale	„ ..	1 in 25	1st, in late Autumn
„ „	Lime Sulphur..	1 in 12	2nd, when buds show more green than pink
Rutherglen Bug	Phenyle Spray	1 qt. phenyle, 1 bar hard soap, 3 lbs. washing soda, 40 gals. water. Dissolve in 4 gals. boiling water; reduce to 40 gals., and add phenyle, &c.	At first appearance of bugs
	or		
	Benzole Emulsion	1 in 4	„ „ „

Bordeaux Mixture.

Dissolve 6 lbs. of bluestone in from 20 or 25 gallons of water, slake 4 lbs. of fresh lump lime by adding water slowly and keeping stirred until turned into milk of lime, and then make up to 20 or 25 gallons of water.

Pour both these mixtures evenly and at the same time into spray pump. Keep well agitated while spraying. An ounce of casein to 10 gallons improves the spread of the Bordeaux mixture if the latter be alkaline.

Copper Soda.

This mixture is made exactly as Bordeaux, only 8 lbs. of washing soda takes the place of the lime.

"Self-boiled" Sulphur.

8 lbs. sulphur.
8 lbs. fresh lump lime.
50 gallons of water.

Place lime in wooden cask, then put in sulphur and add hot water slowly, stirring carefully to prevent "burning" of lime. After slaking is complete allow mixture to stand for fifteen minutes, keeping it covered. Then make up to 50 gallons.

When the self-boiled lime sulphur is to be used for late spraying for peach or other trees with delicate foliage, cold instead of hot water should be used in slaking lime. After the violent boiling which accompanies the slaking has ceased, the mixture should be further diluted with cold water to prevent too much sulphur uniting with lime. If allowed to stand too long a reddish liquid is formed which is injurious to delicate foliage. Hence the necessity of cooling the mixture as soon as lime is well slaked.

Commercial Lime Sulphur.

Lime sulphur concentrate 35 deg. Beaume should be used at 1 to 9½ to kill San Jose, 30 deg. Beaume at 1 to 7½ in winter.

Tobacco Extracts.

Nicotox so far as used has given very good results against aphis.

Black Leaf 40 has also given satisfactory results against the same pest.

Both insecticides should be used at the first appearance of the insect and before it establishes a protection in the folds of the leaves.

Miscible Oil.

A small amount of soap should be used with the oil sprays on the citrus trees. These sprays are more effective if used when the young are just hatched, but still the oil, through "creeping," destroys a vast number of the eggs of the insects.

Pythiacystis Citrophthora.

In treating this disease all branches touching or lying on the ground should be cut off, and the leaves, twigs, and fallen fruit picked up and burned.

Brown Rot.

Experiments are being carried out by the Department this season. All affected parts of trees should, if possible, be cut out when pruning.

SUDAN GRASS (*Andropogon sorghum var.*)

Sudan grass, which belongs to the Sorghum family, is a summer-growing annual noted particularly for its resistance to drought and the rapidity of its growth. It stools freely, giving an abundance of succulent feed much relished by all kinds of stock. It may be grown for pasture, hay, or ensilage. Sudan grass is very similar in appearance to Johnson grass, but differs from it in being an annual. Johnson grass is a perennial, and objectionable on account of the difficulty experienced in eradicating it.

Climatic and Soil Conditions.

Like other Sorghums, Sudan grass does best in a warm climate. It will not grow well in high altitudes where continuous cool weather is experienced. The grass is not exacting in regard to soil, and has been grown successfully on a variety of soils from heavy clays to light sands. On sandy soils, however, it does not yield well, and is best suited by a good loamy soil. Good drainage is essential for the successful growth of this grass.

Preparation of Seed Bed.

The land should be ploughed in the autumn. During the winter months the surface soil should be kept in a loose broken condition with the harrows or cultivator. This assists in consolidating the seed bed as well as conserving the winter rains for the use of the crop. Just prior to sowing, the land may be lightly ploughed or scarified, so as to destroy the weeds, and then harrowed down to produce a fine seed bed. If the crop is to be grown under irrigation, the land should be irrigated just prior to sowing. This is more satisfactory than sowing the seed in a dry seed bed and irrigating afterwards.

Time of Sowing.

This depends chiefly on the locality, nature of the soil, the season, and whether the crop is intended for grain, hay, or green feed. As the plant is likely to be injured by frost it should not be sown until all danger from this source is past. In Victoria sowing may take place from September to December, but preferably in late September or early October. Early sowing is preferred, as it gives the plant a longer growing period, thus enabling it to produce a greater yield.

Seeding.

The seed may be sown broadcast or in drills. If broad-casted or sown in close drills from 12 to 16 lbs. of seed per acre will be required, the lighter seeding being suitable for regions of light summer rainfall,

and the heavier seeding for districts where the summer rainfall is plentiful, or irrigation water is available. In semi-arid districts the seed should be drilled in rows sufficiently far apart to allow cultivation between the rows to be practised. In such cases the rate of seeding will, of course, depend on the distance between the rows. With 21-inch rows, 6 to 8 lbs. of seed per acre will be necessary, while with 28-inch rows from 4 to 6 lbs. of seed should be sufficient. The seed may be sown from the grain-box of the ordinary drill, the spaces between the rows being obtained by blocking up some of the hoes. The drier the district the lighter should be the seeding, and the more vigorous the cultivation between the rows. This aids in the conservation of moisture and the eradication of weeds. The seed should be sown not more than from 1 to 1½ inches deep.

Manures.

Sudan grass responds very readily to superphosphate. In an experiment conducted in New South Wales 1 cwt. of "super." per acre gave an increase in the first cut alone of 73 per cent. over the unmanured check plot. Other manurial trials carried out on various farms have demonstrated clearly that 1 to 2 cwt. of superphosphate or a mixture of equal parts of superphosphate and bonedust can be profitably used.

Pasturing.

In pasturing the majority of Sorghums there is always a danger of prussic acid poisoning. With Sudan grass, however, the danger is much less, and providing caution is exercised, very little danger exists in grazing this grass at any stage of growth unless the plants have suffered a severe check by frost or drought. When the grass is between 18 inches and 2 feet high is considered to be the best time for grazing.

Harvesting.

The grass may be cut for hay with the reaper and binder. It should be allowed to thoroughly cure in the stooks before stacking. The best quality of hay is obtained if cut at the flowering stage.

If cut for seed the first heads should be fully ripe, as the stools will ripen somewhat later than the main stem, and there is little loss of grain through shedding.

ORCHARD AND GARDEN NOTES.

E. E. Pescott, F.L.S., Pomologist.

The Orchard.

If the winter spraying has been delayed, it should be completed as quickly as possible, and before the buds begin to swell and burst.

It is not advisable to spray the stone fruits with the red oil emulsion at this time, as there is danger of burning and destroying the early buds that may be swelling, and consequently loosen their outside scales It will be safe, if the work be done at once, to spray apple, pear and quince trees with this spray, especially where the Eyrobia Mite, scale insects, or woolly aphis are prevalent.

If it is intended that the lime-sulphur wash be the specific for these and other pests, it may be used with safety, although the spraying should be completed as early as possible.

That the lime sulphur is valuable as a specific against "Black Spot" of the apple was shown in the report of the experiments in the *Journal of Agriculture* for August, 1918. The first spray should be given when the flower buds are more green than pink; and the second spray, when the centre flowers of the blossom cluster are pretty open.

The same report showed that a spray of 6.8.40 of copper-soda, sprayed when the earliest buds were showing pink, was a complete success against the "leaf curl" of the peach.

Where peach aphis has appeared, it will be advisable to spray at once with a strong nicotine solution. Tobacco stems should be soaked in cold water for some days, and a teaspoonful of caustic soda added to a cask of steeping stems. The liquid should be made strong, and every endeavour made to kill out the first insects that appear. The preparations known as Black Leaf 40 and Nicotox are useful for this work.

The pruning of deciduous trees should be at an end this month The pruning of evergreens such as oranges, lemons, and guavas, may be left until later.

Young deciduous trees must be planted not later than this month. The soil should be trodden firm round the roots, and, when planting has been completed, the tree ought to be headed back to three or four buds on each arm.

Preparation may be made for planting citrus and other evergreen trees. It is necessary that the soil be well ploughed and sweetened in anticipation of planting in September and October.

In root-borer affected districts, the beetles will begin to appear during the latter part of the month. A close observance should be kept on them and the insects regularly collected and destroyed.

The Flower Garden.

All winter-flowering shrubs that have dropped their blossoms may now be pruned. It is important to prune these immediately after flowering, so that the plant may be able to make plenty of flowering wood for next season.

Seed beds and plots need constant cleaning and weeding. Weeds must now be kept out of the garden, both by hoeing and hand picking. The seedlings growing in their permanent situations should be thinned out and given a good chance to develop strong and sturdy plants.

Divisions of herbaceous plants such as delphiniums, cannas, shasta daisy, herbaceous chrysanthemums, rudbeckias, salvias, and phlox, may still be planted out. If it is intended to leave the plants in the places they occupied last season, they should be lifted, the soil being well dug and manured, and the crowns planted back again. By this means the

plants retain their vigour, and are able to produce good flowers each season.

Evergeen shrubs may now be planted out, if the spots chosen for them have been well dug and aired. All beds should be well dug over by this time, manure and refuse litter having been dug into the soil.

A few corms and tubers of early summer flowering bulbous plants, including Gladioli, may now be planted.

The Vegetable Garden.

The plots should be well dug over at this time, adding gypsum or lime where any pests have been prevalent. In other beds stable manure should be well worked into the soil.

The soil should be rich, well worked, and warm, so that a quick growth may result. Vegetables quickly raised are generally more tender than slowly grown ones; and frequent changes of crops in the plots will give better results. At this season, the weeds will require constant checking; frequent use of the hoe will, therefore, be necessary, and in the rows hand-weeding should be resorted to.

All seedlings should be planted out, especially seedlings of cabbage, cauliflower, lettuce, and onion. Seeds of peas, carrots, parsnips, radish, lettuce, tomato, and broad beans may be sown.

Where they can be sheltered and protected from frosts, young tomato plants may be planted out for early fruiting. One method of managing these early plants is to place the young plant a few inches below the surface, and then a box, 8 or 9 inches deep, with top and bottom removed, over the plant at ground level. This can then be covered loosely with a piece of glass whenever necessary.

Potatoes, artichokes, and asparagus crowns may be planted. Asparagus beds should be kept free from weeds; they should have a loose surface, and a light top dressing with old manure would be beneficial.

In the frames, cucumber, vegetable marrow, melon, pumpkin, water and rock melon seeds may be planted. These are best planted in pots, placing three or four seeds in each pot; they then suffer no check when being transplanted into beds.

REMINDERS FOR SEPTEMBER.

LIVE STOCK.

HORSES.—Feed stabled horses well; give green stuff if available. Continue rugging to encourage the shedding of the coat; good grooming will also be beneficial. Give hay or straw to grass-fed working horses. Feed old and badly-conditioned horses liberally. In foal mares due to foal early, if worked, should be turned out to paddock. Stallions doing stud duty should be fed liberally. Equivalent amount of cracked Indian corn (maize) may with advantage be substituted for oats, if latter grain is scarce.

CATTLE.—Cows should still be rugged, but coverings should be removed frequently, in order to enable the animal to get rid of the old coat; or, better still, a good curry-combing may be given. Continue hay or straw. Look up treatment for milk fever in *Year-Book of Agriculture*, 1905, and treat cattle accordingly. Give calves a good warm dry shed. Give the milk to young

calves at blood heat. Have feeding troughs or buckets clean. Don't over-feed. Feed regularly with regard to quantity and time. Provide a good grass run, or fine hay or crushed oats in a box or trough. Give a cupful of limewater per calf per day in the milk. The problem with many at the present time is how to rear calves without milk. This can be done very well by starting them on new milk for a fortnight, and then gradually substituting the milk with one of the calf meals on the market. To these it would be advisable to add two or three tablespoonfuls of cod liver oil. The following meal is in general use in Ireland :— Two parts, by weight, of oatmeal, 2 parts maize meal, 1 part pure ground linseed, all finely ground. Scald with boiling water, and allow to stand for twelve hours. Start with new milk, then gradually substitute skim and ¼ lb. of the meal mixture per head per day, gradually increasing to 1 lb. or more. In a month milk may be dispensed with altogether. The crushed oats, fed dry, have been found to give excellent results.

Pigs.—Supply plenty of bedding in warm well-ventilated sties. Keep sties clean and dry, and feeding troughs clean and wholesome. Sows may now be turned into grass run. If pigs are lousy dress with kerosene emulsion or sulphur and lard, rubbing well into crevices of skin, and disinfect sties. Worms are very prevalent at present, and may be treated by giving 2 to 10 grains of Santonin in form of pill, or from half to one teaspoonful of oil of turpentine in milk or castor oil.

Sheep.—Wherever early shearing is possible, and shelter available, all sheep to be disposed of can be fattened earlier, if shorn. Sheep, or lambs in the wool, not good enough for freezing, also thrive better after being shorn. Where insufficient knowledge of grading cross-bred wool exists, draft the coarse sheep from the fine before coming into the shed, and shear and bale separately. Clean all daggy sheep before bringing them on to the shearing board. Avoid deep and careless skirting. Only very seedy parts, and heavy fribs and stains should come off fleeces. Press in a box press, which forms square sides to bales, and avoid round bales, called "Sew Downs." Pack in all possible. Brand boldly and neatly on the long and narrow side. Clean carefully all straw, chaff, &c., from shearing place. Cut back all misshapen feet when noticed during shearing. Mark all ewes with misshapen udders, faulty mouths, yellow and common fleeces. Class all well-bred Merino-Longwool cross-lambs before offering to exporters this year. Ear-mark, and keep all best early-born lambs for future breeding and wool-growing. Well-bred, shafty, deep-stapled, fine to medium-grade wools will be required for years. The world has more than an ample supply of short and inferior wool.

Poultry.—September is one of the best months for hatching for winter eggs Incubators should be kept going, and broody hens set. Care must be taken to keep down vermin, as they now breed quickly; use sprays in houses and Insectibane or Izal in nests—nothing stunts chickens quicker than vermin. The food for young chicks should be fine oatmeal, stale bread crumbs or biscuit meal, a little calcined bird's grit, a little chopped green stuff such as lettuce, thistles, or green lucerne or spring onions occasionally cut fine is a good tonic, and a pinch of powdered charcoal. Slightly moisten with new milk. Make the whole friable, and feed frequently ("little and often") just as much as they will readily eat, as an excess of food only sours and disturbs their digestive organs. Animal food may be given in small quantities after the first ten days once or twice a week. Chickens should be protected from damp ground and the cold, bleak winds.

VINEYARD.

Plantation of young vines (grafted or ungrafted) should be concluded before the commencement of September; pruning of old vines likewise, as well as tying down of rods on long-pruned vines. Prune recently-planted vines just before buds commence to swell (if not pruned when planted), cutting strongest cane back to two buds. Do not delay this work until buds have shot, as this seriously weakens the young vine. Field grafting may be carried out, if weather be fine and warm. If cold and wet, postpone until October. Swab vines preventively with acid iron sulphate to protect them from Black spot, or Anthracnose. This fungus was very prevalent on sultanas and other susceptible varieties last season. Should next spring be a wet one, disastrous

outbreaks are probable in vineyards which have not received proper treatment. To avoid burning, swabbing must be completed before the buds commence to swell. A bulletin (No. 42) dealing with this disease will be posted on application. Cultivation (scarifying or discing) must receive attention when soil is in suitable condition.

Cellar.—Conclude spring racking early in month, if not already done. Fill up, regularly, all unfortified wines.

BEE-KEEPING.

During the first or second week of September all hives should be examined to see that each colony has a laying queen and sufficient stores of honey to permit of normal development. Bees work with a reserve of stores at this time of year, and when their supplies are reduced to a certain minimum, brood rearing is restricted, may cease altogether for a time, and when, as a result of prolonged unfavourable weather, the reserve stores are used up, even sealed brood may be torn open and thrown out and the colonies practically ruined for the season.

Strong colonies should have 15 to 20 lbs. of honey ahead of daily requirement, medium and small colonies proportionately less. When during the examination of the hives less than this amount is found, the shortage should be made good by feeding, blood-warm, and inside the hive, a syrup made by dissolving 1½ or 2 parts of best white sugar in one part of boiling water. What is known as a frame feeder is the most suitable one for this purpose, or a simplicity feeder in a shallow super over the brood chamber may be used.

When no feeders are on hand, the syrup may be poured in a fine stream from the lip of a jug into an empty comb laid flat into a suitable dish. The jug should be held about 12 to 15 inches above the comb, otherwise the syrup will not enter the cells. After filling both sides, and keeping it in an upright position for a few minutes to drain off the surplus, the comb can be returned to the hive, repeating the operation on succeeding days till the needs of the colony are supplied.

Any colony found queenless, as indicated by the absence of brood or eggs, may be kept going till a queen can be raised or procured, by giving a comb of eggs or young brood from a strong colony once a week, provided there are sufficient bees left to make it worth while; if too small, unite with the nearest normal colony.

In early districts and where colonies went into Winter strong in bees, swarms may be expected from the middle of September onwards. Hives and frames for the number of first swarms expected should be on hand and ready for immediate use, so that none of the bees' labour may be wasted by allowing them to build comb in a temporary box. All frames should be wired so that newly-built comb may not break down in handling or during hot weather. Under normal conditions a swarm with a good fertile queen will build all worker comb during the first three weeks. It is the only time a full colony will not build drone comb from starters of foundation. While the queen deposits eggs into the worker cells as fast as they are constructed by the bees there will be no drone cells built. After three weeks the young bees from the first-laid eggs will hatch out, and the queen will return to that part of the comb to again deposit eggs into the vacated cells, and the newly-constructed cells on the edges of the comb being neglected by the queen, the remainder of the space in the frames will be filled with drone comb.

The aim of the bee-keeper, therefore, is to confine the building of comb from starters to the number of frames likely to be completed during the first three weeks after hiving the swarm, by removing two, three, or four frames in which no comb has been built four or five days after hiving. The follower or dummy board is pushed up against the remaining frames, and when these are completed frames with full sheets of foundation are added to make up the set.

Hives should always stand level, crossways to the frames; in the case of swarms hived on starters of foundation it is particularly important. Comb is always built truly perpendicular, and if the hive is not level to the frames the wires will be outside, instead of in the centre of the comb.

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A valuable Native Grass. Grows equally well in the coastal districts and in the interior. Particularly adapted to poorer soils unsuited to other grasses. It is highly nutritious, and stock of all kinds eat it readily; very fattening. The roots of this grass penetrate to a great depth, which enables the plant to withstand long spells of dry weather. The seed is very light, and a small quantity will cover a good breadth of land; we would recommend that one or two pounds per acre should be added to all mixtures for any soil or climate.

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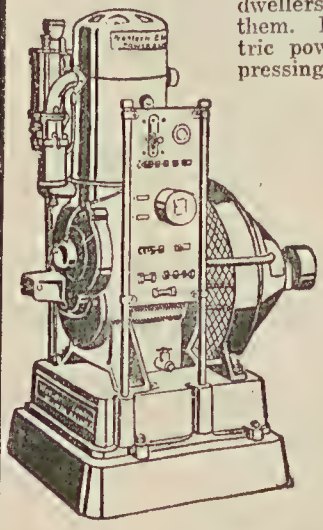

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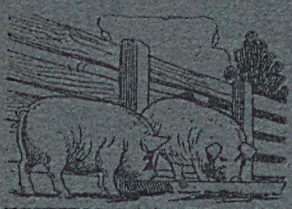

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